SOIL SURVEY OF

Castro County, Texas

United States Department of Agriculture Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station
Issued June 1974

Major fieldwork for this soil survey was done in the period 1963-69. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1969. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Running Water Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Castro County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The “Guide to Mapping Units” can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification and range classification of each. It also shows the page where each soil is described.

Individual colored maps showing the relative, suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and ranchers and those who work with them can learn about use and management of the soils from the soil descriptions, from the explanation of the capability classification, and from the discussion of range management.

Game managers, sportsmen, and others interested in the management of wildlife habitat can find useful information in the section “Wildlife.”

Engineers and builders can find, under “Engineering Uses of the Soils,” tables that contain estimates of soil properties and interpretations of soil properties as they affect engineering practices.

Community planners and others can find, in the tables of engineering data, information about soil properties that affect the choice of sites for nonindustrial buildings and for recreational areas.

Scientists and others can read about how the soils formed and how they are classified in the section “Formation and Classification of the Soils.”

Newcomers to the county may be especially interested in the section “General Soil Map,” where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning and end of the publication.

Cover picture: Grain sorghum grown under irrigation on Pullman clay loam, 0 to 1 percent slopes. A swath (foreground) has been cut for a moisture check. City of Dimmitt in background.

Contents

How this survey was made 2
General soil map 3
1. Pullman association 3
2. Olton association 4
3. Estacado association 5
4. Estacado-Berda-Bippus association 5
5. Acuff association 6
6. Lipan-Estacado association 6

Descriptions of the soils 6
- Acuff series 7
- Berda series 10
- Bippus series 12
- Drake series 15
- Estacado series 16
- Lipan series 19
- Lofton series 21
- Mansker series 22
- Olton series 25
- Posey series 28
- Potter series 31
- Pullman series 33
- Randall series 36
- Spur series 38

Use and management of the soils 39
- Capability grouping 40
- Predicted yields 42
- Range management 42
  - Range sites and condition classes 43
- Wildlife 43
  - Interpretations for wildlife habitat 44
- Engineering uses of the soils 44
  - Engineering classification systems 46
  - Estimated engineering properties 47
  - Interpretations of engineering properties 47

Formation and classification of the soils 48
- Factors of soil formation 50
  - Parent material 50
  - Climate 50
  - Plant and animal life 51
  - Relief 52
  - Time 52
- Classification of the soils 53

Climate 54
History and settlement 55
Literature cited 56
Glossary 57

SOIL SURVEY OF CASTRO COUNTY, TEXAS

BY HERBERT E. BRUNS, SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

CASTRO COUNTY is in the western part of the Panhandle of Texas (fig. 1). It has an area of 563,200 acres, or about 880 square miles. The elevation ranges from about 4,000 feet in an area north of Tam Anne to about 3,600 feet along North Fork of Running Water Draw.

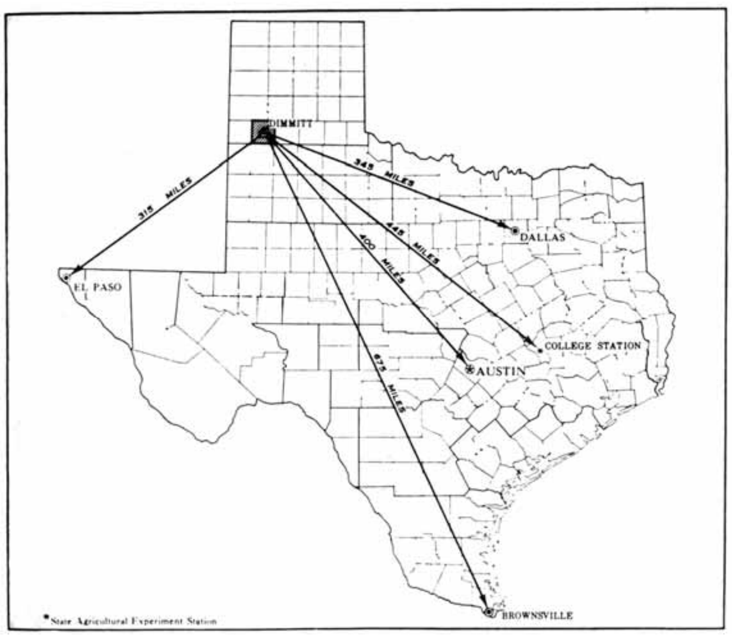


Figure 1.—Location of Castro County in Texas.

Castro County is in the southern part of the Great Plains, which extend from Texas into Canada. The county is part of the High Plains, a smooth tableland broken by playa basins and entrenched draws. The High Plains formed from Rocky Mountain outwash (2) and an overlying eolian mantle (3). This is underlain by older Triassic and Permian red beds.

The outwash, composed of finer textured sand and calcareous loam soil material underlain by coarse, gravelly material, is the Ogallala Formation. It is over the Triassic red beds. The Ogallala Formation in this county ranges from 100 to 600 feet in thickness. The source of the underground water used for nearly all irrigation is the saturated sand and gravel at the base of the Ogallala Formation.

Irrigated grain sorghum and wheat are the main crops grown in the county. Irrigated cotton, vegetables, and sugar beets are grown on significant acreages. Beef production is very important. Thousands of cattle are fattened each year in feedlots, where vegetable by-products, hay, silage, and locally grown grain are used as feed.

Grain sorghum and wheat are also dryfarmed. Nearly all of the dryfarmed acreage is in the northeastern part of the county.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Castro County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams: the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic, feature near the place where a soil of that series was first observed and mapped. Acuiff and Olton, for example, are the names of two soils series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management.

For example, Acuff loam, 0 to 1 percent slopes, is one of three phases within the Acuff series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have, been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Castro County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of two or more dominant soils, and the pattern and relative proportions are about the stone in all areas. The names of some complexes consist of the names of two or more dominant soils, joined by a hyphen. Mansker-Berda loams, 5 to 8 percent slopes, is an example. Other complexes are named for a single dominant soil. Posey complex, 0 to 1 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by “and.” Bippus and Spur soils, frequently flooded, is an example.

While a soil survey is in progress, data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil, and yields under defined management are estimated for the soils suitable for crops.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, ranchers, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Castro County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of use. Such a map is a useful general guide in managing a watershed or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The six soil associations in Castro County are described in the following pages. The texture described in the title of each association is that of the surface layer. For example, the word “loamy” in the title of association 1 refers to the texture of the surface layer.

1. Pullman association

Nearly level to gently sloping, deep noncalcareous, very slowly permeable, loamy soils on uplands

This association makes up about 51 percent of the county. The landscape of this association (fig. 2) lacks prominent features but is characterized by a few slight rises and many dish-shaped depressions or playas, in which water accumulates.

Pullman soils make up about 89 percent of the association, and minor soils the remaining 11 percent.

Pullman soils have a surface layer of dark-brown clay loam about 8 inches thick. The next layer is dark-brown clay about 13 inches thick. Below this is brown clay about 9 inches thick. The next layer is yellowish-red clay about 11 inches thick. This is underlain, to a depth of 84 inches, by silty clay loam that is pink in the upper part and reddish yellow in the lower part.

Minor soils in this association are mainly those of the Randall, Estacado, Olton, Lofton, Lipan, Acuff, Drake, and Posey series.

Most of the dryfarmed acreage in the county is within this association, and also much of the irrigated acreage. Pullman soils are well suited to surface irrigation because they are smooth and nearly level. A few small areas of this association are used for range. Farms range from 320 to 2,000 acres in size.

2. Olton association

Nearly level to gently sloping, deep, noncalcareous, moderately slowly permeable, loamy soils on uplands

This association makes up about 31 percent of the county. Most of these soils are nearly level. A few small areas are gently sloping around playas.

Olton soils make up about 84 percent of the association, and minor soils the remaining 16 percent.

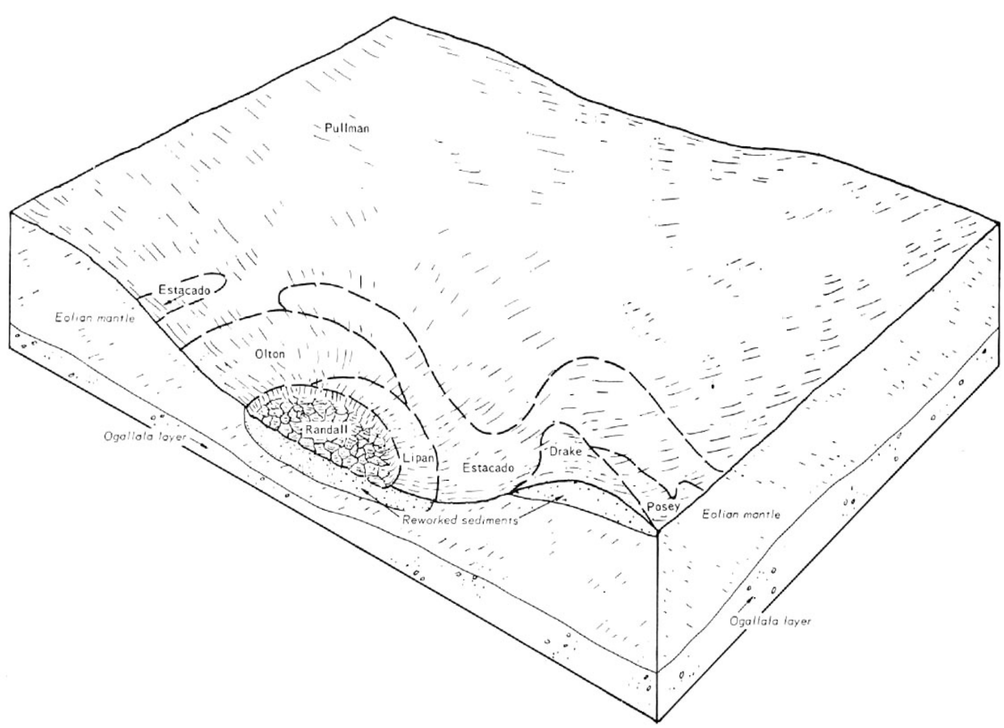


Figure 2.—Typical pattern of soils and landscape features in association 1.

Olton soils have a surface layer of dark-brown clay loam about 9 inches thick. The next layer is reddish-brown clay loam about 30 inches thick. Below this, to a depth of about 61 inches, is pink clay loam.

Minor soils in this association are mainly those of the Estacado, Acuff, Randall, Pullman, Lofton, Lipan, and Posey series.

This association is used mostly for irrigated crops. Irrigation is by surface methods. Small areas, mostly associated with gently sloping soils, are used for pasture. A few small areas are used for native rangeland.

3. Estacado association

Nearly level to gently sloping, deep, calcareous, moderately permeable, loamy soils on uplands

This association makes up about 8 percent of the county.

Estacado soils make up more than 75 percent of the association, and minor soils the remaining 25 percent.

Estacado soils have a surface layer of dark grayish-brown clay loams about 15 inches thick. The next layer is pale-brown and very pale brown clay loam about 23 inches thick. Below this, to a depth of about 80 inches, is reddish-yellow clay loam.

Minor soils in this association are mainly those of the Posey, Olton, Randall, Lipan, Drake, Acuff, and Mansker series.

Most of this association is in cultivation and is irrigated. A few small areas are in native rangeland.

4. Estacado-Berda-Bippus association

Nearly level to sloping, deep, calcareous, moderately permeable, loamy soils on side slopes and bottom lands

This association (fig. 3) makes up about 6 percent of the county.

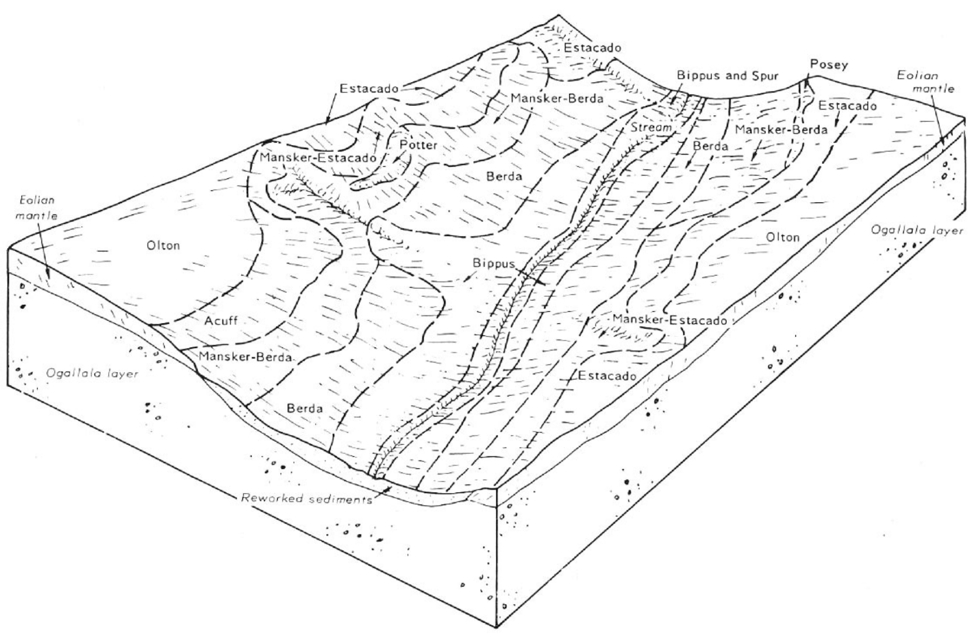


Figure 3.—Typical pattern of soils and landscape features in association 4.

Estacado soils make up about 24 percent of the association, Berda soils about 15 percent, Bippus soils about 14 percent, and minor soils the remaining 47 percent.

Estacado soils have a surface layer of dark grayish-brown clay loam about 15 inches thick. The next layer is pale-brown and very pale brown clay loam about 23 inches thick. Below this, to a depth of about 80 inches, is reddish-yellow clay loam.

Berda soils have a surface layer of dark grayish-brown fine sandy loam about 8 inches thick. The next layer is grayish-brown fine sandy loam about 18 inches thick. Below this is pale-brown loam about 19 inches thick. The underlying material, to a depth of 60 inches, is brown loam.

Bippus soils have a surface layer of dark grayish-brown clay loam, about 23 inches thick. The next layer, about 36 inches thick, is brown clay loam. The underlying material, to a depth of 83 inches, is brown clay loam.

Minor soils in this association are mainly those of the Potter, Mansker, Olton, Acuff, Pullman, Spur, and Posey series.

This association is used mostly for rangeland. A few small areas are used for irrigated cropland.

5. Acuff association

Nearly level to gently sloping, deep, noncalcareous, moderately permeable, loamy soils on uplands

This association makes up about 2 percent of the county. It is a level plain except for playas.

Acuff soils make up about 80 percent of the association, and minor soils the remaining 20 percent.

Acuff soils have a surface layer of brown loam about 10 inches thick. The next layer is reddish-brown sandy clay loam about 26 inches thick. Below this is pink sandy clay loam about 26 inches thick. It is underlain, to a depth of about 80 inches, by light reddish-brown sandy clay loam.

Minor soils in this association are mainly those of the Estacado, Randall, and Olton series.

Most of this association is cultivated, and most of the cultivated acreage is irrigated. A few small areas are used for rangeland.

6. Lipan-Estacado association

Nearly level to gently sloping, deep, calcareous, very slowly to moderately permeable, clayey and loamy soils in large basins.

This association makes up about 2 percent of the county. Lipan soils make up about, 25 percent of the association, Estacado soils about 21 percent, and minor soils the remaining 54 percent.

Lipan soils have a surface layer of dark-gray and gray clay about 21 inches thick. The next laver is grayish-brown clay about 15 inches thick. Below this is light brownish-gray clay about 18 inches thick. The underlying material is white clay that ranges to light gray.

Estacado soils have a surface layer of calcareous, dark grayish-brown clay loam about 15 inches thick. The next layer is pale-brown and very pale brown clay loam about 23 inches thick. Below this, to a depth of about 80 inches, is reddish-yellow clay loam.

Minor soils in this association are mainly those of the Randall, Berda, Drake, Acuff, Mansker, Pullman, Olton, and Lofton series.

Most of this association is used for rangeland. The nearly level areas are cultivated. The cultivated areas are either irrigated or dryfarmed.

Descriptions of the Soils

This section describes each of the soil series and mapping units in Castro County. The procedure is to describe first the soil series and then the mapping units, or kinds of soil, in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which it belongs.

Each soil series contains a short narrative description of a profile considered representative of the series, and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. The colors described are for dry soil, unless otherwise noted.

Some of the terms used in the soil descriptions are defined in the Glossary, some in the section “How This Survey Was Made,” and some in the Soil Survey Manual (5). The approximate acreage and proportionate extent of each soil mapped are shown in table 1. At the back of this soil survey is the “Guide to Mapping Units,” which lists the mapping units in the county and shows the capability unit (irrigated, dryland, or both) and range site each mapping unit is in.

Acuff Series

The Acuff series consists of deep, nearly level to gently sloping, noncalcareous, loamy soils. These soils formed in eolian deposits of sandy-clay loam texture.

In a representative profile (fig. 4), the surface layer consists of brown loam about 10 inches thick. Below this is a layer of reddish-brown sandy clay loam about 26 inches thick. The next layer, about 26 inches thick, consists of pink sandy clay loam that is about 55 percent lime. At a depth of about 62 inches is light reddish-brown sandy clay loam that extends to a depth of about 80 inches.

Figure 4.—Profile of an Acuff loam. The layer of calcium carbonate accumulation begins at a depth of about 36 inches.

These soils are well drained and are moderately permeable. The available water capacity is high, and runoff is slow.

Representative profile of Acuff loam, 1 to 3 percent slopes, 7 miles south and 2 miles west of Flagg (150 feet south and 80 feet east of the northwest corner of section 30, Halsell, block 2):

Ap—0 to 10 inches, brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) moist; weak, medium, granular structure; slightly hard, very friable, plastic, slightly sticky; neutral; abrupt, smooth boundary.

B21t—10 to 17 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) moist moderate, coarse, prismatic structure parting to moderate, coarse, subangular blocky and granular structure; very hard, friable, plastic, slightly sticky; common very fine pores; many worm casts; few clay films on subangular blocks; neutral; clear, smooth boundary.

B22t—17 to 36 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate to weak, coarse, subangular blocky structure; hard, friable, plastic, slightly sticky; many fine pores; few worm casts; few clay films; few threads of calcium carbonate beginning at a depth of 25 inches; calcareous; moderately alkaline; clear, smooth boundary.

B23tca—36 to 62 inches, pink (5YR 8/3) sandy clay loam, pink (5YR 7/4) moist; weak, coarse, subangular blocky structure; hard, friable, slightly sticky, plastic; many fine pores; about 55 percent calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B24t—62 to 80 inches, light reddish-brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/5) moist; slightly hard, friable, plastic, slightly sticky; many very fine and fine pores; few clay films and sand bridges; 5 to 10 percent fine and medium concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 10 to 12 inches in thickness and is brown, dark brown, or reddish brown in color. The B2t1 horizon ranges from 7 to 14 inches in thickness. It is sandy clay loam or clay loam in texture. It ranges from reddish brown to brown in color but is dominantly reddish brown. The B22t horizon ranges from reddish brown and yellowish red to reddish yellow in color. The clay content of the B21t and B22t horizons is 25 to 35 percent, by volume. Secondary carbonates occur at a depth of 18 to 28 inches. The depth to the B23tca horizon ranges from 35 to 60 inches. This horizon ranges from pinkish white to reddish yellow in color but is dominantly pink. The calcium carbonate content ranges from 35 to 60 percent, by volume. The depth to the B24t horizon ranges from 45 to 70 inches. It is light reddish brown, reddish yellow, or yellowish red in color. Carbonates in this horizon range from thin, soft coatings and threads to vertical stringers containing cemented concretions.

Acuff loam, 0 to 1 percent slopes (AcA).—This soil is on broad, smooth plains. Most areas range from 10 to 150 acres in size.

This soil has a surface layer of brown loam about 12 inches thick. The next layer, to a depth of about 40 inches, is reddish brown sandy clay loam that is calcareous in the lower part. Below this, to a depth of about 60 inches, is pink sandy clay loam that contains about 45 percent calcium carbonate. Below a depth of 60 inches is calcareous, reddish-yellow sandy clay loam.

Included with this soil in mapping are round spots of Estacado soils. They are numerous in most areas but are less than 1 to 2 acres in size. Also included are oval spots of Olton soils that are less than 5 acres in size. These inclusions make up less than 2 percent of any one area. A few areas are underlain by indurated caliche at depths of 30 to 40 inches.

Small areas of this soil are used for range. Most of this soil is irrigated. Irrigation systems need to be so designed and installed that they do not increase the risk of erosion. Diversion terraces, grassed waterways, and other erosion control measures are needed in some places.

The hazard of water erosion is slight, and the hazard of soil blowing is moderate. A few spots have been moderately damaged by soil blowing. In most cultivated areas, the plowed layer has been winnowed and consequently has a somewhat sandier texture than the surface layer in areas still in grass.

Soil blowing can be controlled by leaving crop residue on the surface (fig. 5). Fertilizer and high-residue crops are needed to keep the soil in good condition if it is irrigated.

The dominant climax grass on this soil is blue grama. Buffalograss becomes more abundant if a site is over-grazed. The main invaders are three-awn and annual weeds. The total annual production of air-dry herbage on range in excellent condition is 1,200 to 2,000 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-4, dryland, and IIe-1, irrigated; Deep Hardland range site)

Acuff loam, 1 to 3 percent slopes (AcB).—Areas of this soil are elongated ovals that are 10 to 50 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping are small spots of Estacado soils and areas of Olton soils that are a few acres in size.

Much of this soil is irrigated. Small areas remain in native range. This soil is well suited to dryland crops. If this soil is dryfarmed, terraces and contour farming are needed to control water erosion. If this soil is irrigated, management needs include fertilization, use of crop residue, rotation of crops, and management of irrigation water in an irrigation system designed to fit the requirements and limitations of the soil. The hazards of water erosion and soil blowing are moderate. The residue from crops helps to control soil blowing and water erosion.

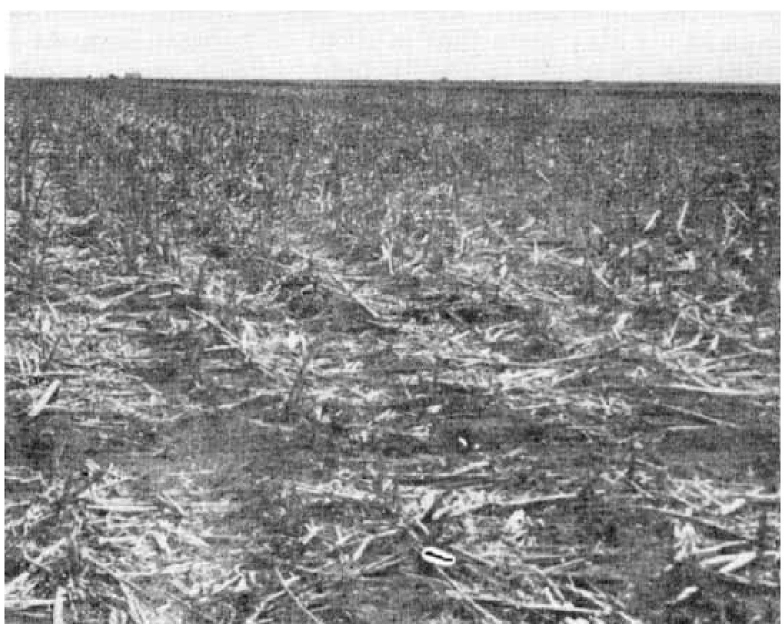


Figure 5.—Grain sorghum stubble left standing for protection against soil blowing. The soil is Acuff loam, 0 to 1 percent slopes.

Blue grama is the dominant climax grass on this soil. Buffalograss becomes more abundant if a site is over-grazed. The main invaders are three-awn and yucca. The total annual production of air-dry herbage on range in excellent condition is 1,200 to 2,000 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-2, dryland, and IIIe-2. irrigated; Deep Hardland range site)

Acuff loam, 3 to 5 percent slopes (AcC).—This soil is in crescent-shaped bands on the northwestern slopes bordering playas and in oblong bands along sides of the draws. The areas are 10 to 35 acres in size.

This soil has a reddish-brown surface layer about 10 inches thick. The next layer is reddish-brown sandy clay loam about 26 inches thick. Below this is pinkish-white sandy clay loam about 24 inches thick. Below a depth of 60 inches is reddish-yellow sandy clay loam.

Included with this soil in mapping are a few spots of Mansker soils. Also included are areas of Olton soils that make up 3 to 5 percent of most areas.

Most of this soil is in native grasses. In the few areas that are cultivated, about half of the surface layer has been removed by water erosion. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. Level borders, management of crop residue, on the surface, terracing, and contour farming can be used to control further erosion.

Blue grama is the dominant climax grass on this soil. Buffalograss becomes more abundant if a site is over-grazed. The main invaders are three-awn and yucca. The total annual yield of air-dry herbage on range in excellent condition is 1,200 to 2,000 pounds per acre, depending on variations in rainfall. (Capability unit IVe-1, dryland, and IIIe-3, irrigated; Deep Hardland range site)

Berda Series

The Berda series consists of deep, gently sloping to sloping, calcareous, loamy soils. These soils formed in reworked materials of the eolian mantle.

In a representative profile, the surface layer is calcareous, dark grayish-brown fine sandy loam about 8 inches thick. The next layer, about 18 inches thick, is calcareous, grayish-brown fine sandy loam that contains many worm casts. Below this is calcareous, pale-brown loam about 19 inches thick. The underlying material is brown loam to a depth of about 60 inches.

The Berda soils are well drained and moderately permeable. The available water capacity is high, and runoff is medium.

Representative profile of Berda fine sandy loam, 5 to 8 percent slopes, 1 mile west of Sunnyside on county road and 900 feet south in rangeland (300 feet west and 900 feet south of the northeast corner of section 11, Halsell, block 1):

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky and granular structure; slightly hard, friable; few fine concretions of calcium carbonate; very porous; few worm casts common in lower part of horizon; calcareous; moderately alkaline; clear, smooth boundary.

B21—8 to 26 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, very coarse, prismatic, structure parting to weak, medium, subangular blocky and granular structure; hard, friable; many roots; very porous; many worm casts in upper two-thirds of horizon and common in lower one-third; faint films of calcium carbonate on ped surfaces; numerous threads of calcium carbonate; few, fine, soft calcium carbonate masses; few fine concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

B22ca—26 to 45 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak, coarse, prismatic structure; hard, friable; very porous; few worm casts in upper part; many threads and films of calcium carbonate, about half are indistinct; few, fine, soft calcium carbonate masses; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—45 to 60 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; massive; hard, friable; many threads and films of calcium carbonate; few, fine, soft calcium carbonate masses; few fine concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 6 to 9 inches in thickness. It is dark grayish brown, dark brown, brown, and grayish brown in color. It is mostly fine sandy loam in texture, but it ranges to loam. The B21 horizon is light brown, brown, pale brown, or grayish brown. It is similar in texture to the A horizon, but it is slightly more clayey. In profiles that have a loam A horizon, the B21 horizon is mainly clay loam. The B21 horizon extends to a depth of 20 to 30 inches. The clay content of the B21 horizon ranges from 18 to 32 percent, by volume. The B22ca and C horizons are brown, light-brown, or pale brown calcareous loam or fine sandy loam. The B22ca horizon contains slightly more calcium carbonate than the B21 horizon but less than 5 percent more than the C horizon.

Berda fine sandy loam, 3 to 5 percent slopes (BeC).—This soil is mostly on foot slopes. Areas are generally long and narrow, are about 400 to 800 feet wide, and follow the contour of the side slopes of the draws. The areas range from 15 to 70 acres in size.

The surface layer is dark grayish-brown fine sandy loam about 9 inches thick. The next layer is grayish-brown fine sandy loam about 18 inches thick. Below this is pale-brown loam about 15 inches thick. The underlying material, to a depth of 60 inches, is brown loam.

Included with this soil in mapping are small areas of Posey soils on the upper parts of slopes and Bippus soils on the lower parts of slopes. Also included are a few small areas of Acuff and Olton soils. A few spots of Potter soils are also included.

Some areas of this soil are cultivated. Grain sorghums and forage sorghums are the main crops. Terraces, contour farming, diversion terraces, and grassed waterways to carry off excess water are needed. This soil is easy to work. If it is irrigated, alfalfa, perennial grasses, and other soil-improving crops are needed to maintain tilth. A sprinkler system of irrigation is better suited to this soil than are other irrigation methods. Growing residue-producing and protective crops continuously, with adequate fertilization, limited tillage, and crop residue left on the surface, helps to reduce soil blowing and water erosion. Pastures need grazing management, fertilization, frequent irritation, and rotation grazing for good results.

In areas of this soil in range are mixtures of blue grama and side-oats grama and a scattering of yucca. Sagebrush is in a few areas and is becoming thicker. The better grasses are side-oats grama, little bluestem, and blue grama. Buffalograss, three-awn, and hairy grama become more abundant if the site is overgrazed. Invaders are mainly western ragweed, yucca, and annual weeds and grasses. Total annual production of air-dry herbage on range in excellent condition is 1,200 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IVe-3, dryland, and IVe-1, irrigated; Mixedland Slopes range site)

Berda fine sandy loam, 5 to 8 percent slopes (BcD).—This soil is on foot slopes along draws. The areas are 15 to 250 acres in size. Slopes range from 5 to 8 percent but are mainly about 6 percent. This soil has the profile described as representative for the series.

Included with this soil in mapping are spots of Potter soils that make up as much as 5 percent of small areas of this Berda soil. Also included are areas of Mansker soils that surround the Potter inclusions and some areas of Acuff loam. On upper or lower slopes, some areas of Berda fine sandy loam, 3 to 5 percent slopes, are also included.

Most of this soil is in rangeland. Because of slope, this soil should not be cultivated. The hazard of water erosion is severe. The hazard of soil blowing is moderate. The native vegetation consists of blue grama, side-oats grama and scattered yucca. A few areas that have been cultivated are now in grass. These areas have some gullies.

The better grasses on this soil are side-oats grama, little bluestem, and blue grama. Buffalograss, three-awn, and hairy grama become more abundant if a site is overgrazed. Invaders are mainly western ragweed, yucca, and annual weeds and grasses. In a few areas, sagebrush is becoming thicker. The total annual production of air-dry herbage on range in excellent condition is 1,200 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit VIe-1 dryland; Mixedland Slopes range site)

Bippus Series

The Bippus series consists of deep, nearly level to gently sloping, loamy soils. These soils formed in reworked materials of the eolian mantle.

In a representative profile, the surface layer is dark grayish-brown clay loam about 23 inches thick. Below this is brown, friable clay loam that extends to a depth of 83 inches.

These soils are moderately permeable and are well drained. They are flooded for short periods following heavy rains. The available water capacity is high and runoff is medium to rapid.

Typical profile of Bippus clay loam, 0 to 1 percent slopes, located 4.9 miles west and 0.5 mile south of Hart in rangeland (700 feet east, and 2,620 feet south of the northwest corner of section 24, block 0-7):

A11—0 to 9 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to moderate, coarse and medium, subangular blocky and granular structure; weak, fine, platy structure in top inch; hard, friable, slightly sticky, plastic; many fine and very fine roots; many fine and few medium pores (old root channels); common worm casts; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

A12—9 to 23 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky and granular structure; hard, friable, slightly sticky, plastic; many fine and very fine roots; many fine and few medium pores (old root channels); common worm casts; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B21—23 to 45 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, subangular blocky structure parting to fine, granular structure; very hard, friable, slightly sticky, plastic; common fine roots; many fine and few medium pores (old channels); few worm casts; few very fine calcium carbonate concretions and threads; calcareous; moderately alkaline; gradual, smooth boundary.

B22ca—45 to 59 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) moist; moderate, medium, subangular blocky structure parting to fine, granular structure; very hard, friable, slightly sticky, plastic; few fine roots; many fine and few medium pores; few worm casts; many calcium carbonate threads, few films, and few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C1ca— 59 to 72 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky, plastic; few fine roots; many fine pores; many threads and films and few, fine, soft masses of calcium carbonate; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C2—72 to 83 inches, brawn (7.5YR 5/3) clay loam, dark brown (7.5YR 4/4) moist; massive; very hard, friable, slightly sticky, plastic; few fine roots porous; many threads and films and few, fine soft masses of (alleluia carbonate; few fine calcium carbonate concretions; calcareous; moderately alkaline.

The upper part of the A horizon ranges from clay loam to fine sandy loam in texture and from brown, dark brown, and dark grayish brown to very dark grayish brown in color. The total thickness of the A horizon ranges from 20 to 36 inches. The combined thickness of the B21 and B22ca horizons ranges from 12 to 36 inches. These horizons are brown, dark brown, reddish brown or light reddish brown in color and range from clay loam to loam in texture. Their structure is moderate, medium to fine, subangular blocky.

Bippus clay loam, 0 to 1 percent slopes (BpA).—This soil is on old flood plains and bottoms along the draws and their tributaries. Most areas are less than 400 feet wide and extend several miles along the draw. This soil has the profile described as representative for the series.

Included with this soil in mapping are small spots of Lofton, Spur, and Randall soils.

This soil is suited to dryfarmed or irrigated crops, but most of it is not farmed, because channel cutting has produced smaller, isolated areas and because most, areas of adjoining soils, such as the Berda and Mansker soils, are sloping and not suitable for farming. Only a limited acreage of this soil is used for irrigated crops, and a small acreage is in irrigated pasture, mostly bermudagrass. Soil blowing is a slight, hazard where this soil is dryfarmed, and erosion caused by occasional flooding is a moderate hazard where the soil is irrigated.

If this soil is dryfarmed, management should include leaving crop residue on the surface, because this helps to control soil blowing and water erosion. Timely but limited tillage, diversion terraces, and grassed waterways also are needed.

If this soil is irrigated, management needs include use of fertilizer, use of crop residue, rotation of crops, and management of irrigation water in a system designed to fit the requirements and limitations of the soil.

Blue grama is the dominant climax grass on this soil, and there are traces of side-oats grama in a few places. Buffalograss becomes more abundant if a site is over-grazed. Most areas of range on this soil are kept in good condition. The total annual production of air-dry herbage on range in excellent condition is 1,500 to 2,400 pounds per acre, depending on variations in rainfall. (Capability unit IIe-1, dryland, and IIe-1, irrigated; Deep Hardland range site)

Bippus clay loam, 1 to 3 percent slopes (BpB).—This soil is on valley fills and fans along draws. A few areas are along some of the short draws that drain into larger playas of the county. Slopes are smooth and, in most places, slightly concave. They average about 1.5 percent but range from 0.7 to 3 percent. The average area is about 30 acres in size.

This soil has a dark grayish-brown clay loam surface layer about 21 inches thick. Below this layer is brown calcareous clay loam that extends to a depth of about 70 inches. The lower layer is calcareous clay loam and is enriched with carbonates in the upper part.

Included with this soil in mapping are areas of Estacado soils. Also included are areas that have slopes of less than 1 percent and areas in which the surface layer is only 12 inches thick.

A few areas of this soil are cultivated, but almost all of the acreage remains in rangeland. The hazard of soil blowing is slight, and that of water erosion is moderate. Soil blowing can be controlled by managing crop residue on the surface. Terracing and contouring help to control water erosion. Diversions and grassed waterways are needed in places. If this soil is irrigated, use of fertilizer, management of crop residue, rotation of crops, and management of irrigation water in an irrigation system designed to fit the requirements and limitations of the soil are needed.

Blue grama is the dominant climax grass on this soil. Traces of side-oats grama grow in a few areas. Buffalograss becomes more abundant if a site is overgrazed. The main invaders are three-awn and broom snakeweed. Grazing should be regulated so that a high percentage of blue grama is maintained. Most areas of range on this soil are kept in good condition. The total annual production of air-dry herbage on range in excellent condition is 1,500 to 2,400 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-2, dryland, and IIIe-2, irrigated; Deep Hardland range site)

Bippus and Spur soils, frequently flooded (Bs).—These soils consist of old floodplain deposits in draws along intermittent streams (fig. 6). They form an almost continuous strip that is mainly 200 to 400 feet wide but is as much as 1,000 feet wide in a few places. This strip has uneven relief.

Figure 6.—Bippus and spur soils, frequently flooded, shortly after a 2-inch rain in the watershed. The Spur soils are covered by flowing water.

Bippus soils make up about 75 percent of this mapping unit, and Spur soils 10 to 20 percent. About 5 to 15 percent of the acreage is a scoured stream channel. Included with these soils in mapping, in the channel and a few other places, are a few, concave, depressional areas of dark-gray clay. Also included are small areas of Berda soils.

Bippus soils in this mapping unit have a dark-brown clay loam surface layer about 30 inches thick. The next layer, to a depth of 70 inches, is brown clay loam. The Spur soils have the profile described as representative for the Spur series. Spur soils are the channel area.

These Bippus and Spur soils are almost all in rangeland. They are not suited to cultivation. The plant cover on the Spur soils ranges from none in some areas to thick in other areas. All acreage of Bippus soils is thickly vegetated.

The dominant climax grasses on these soils are blue grama, western wheatgrass, and vine-mesquite. Sand sage-brush is the most common range shrub. The total annual yield of air-dry herbage on range in excellent condition is 1,500 to 2,800 pounds per acre, depending on variations in rainfall and the frequency of flooding. (Capability unit Vw-1, dryland; Loamy Bottomland range site)

Drake Series

The Drake series consists of deep, gently sloping to sloping, calcareous, loamy soils that are weakly developed in strongly calcareous, windblown sediments. These soils are on the caps of old dunes on the lee side of playa basins. The dunes formed in windblown materials.

In a representative profile, the surface layer is grayish-brown loam about 8 inches thick. The next layer is clay loam about 19 inches thick. It is light gray in the upper part and white in the lower part. It is underlain, to a depth of about 82 inches, by light-gray sandy clay loam.

Drake soils are well drained. The permeability and available water capacity are moderate. Because the content of lime is high, some nutrients are not available to plants. This lack of nutrients causes chlorosis, as is indicated by the yellowing of the leaves of grain sorghum.

Representative profile of a Drake loam in an area of Drake soils, 2 to 5 percent slopes, 4.5 miles north of Easter in pit on west side of Farm Road 1055 in rangeland (2,700 feet south and 100 feet west of the northwest corner of section 117, block M-7):

A1—0 to 8 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, very coarse, prismatic structure parting to weak, subangular blocky and granular structure; slightly hard, very friable, slightly plastic; common fine pores and worm casts; calcareous; moderately alkaline; diffuse, smooth boundary.

C1—8 to 19 inches, light-gray (10YR 7/2) clay loam, pale brown (10YR 6/3) moist; weak, coarse, prismatic and subangular blocky structure parting to granular structure; slightly hard, very friable, plastic; common to few worm casts in lower part; calcareous; moderately alkaline; clear, smooth boundary.

C2—19 to 27 inches, white (2.5Y 8/2) clay loam, light brownish gray (2.5Y 6/2) moist; weak, medium, prismatic and subangular blocky structure; slightly hard, very friable; very porous; few worm casts; calcareous; moderately alkaline; clear, smooth boundary.

C3—27 to 82 inches, light-gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; weak, coarse, prismatic structure; slightly hard, very friable; few partly decayed roots; porous; calcareous; moderately alkaline.

These soils are mostly loam in texture but range from fine sandy loam to sandy clay loam or clay loam. The A horizon ranges from 5 to 10 inches in thickness and from grayish brown to light brownish gray in color. The C1 horizon is light gray, light brownish gray or pale brown in color and is clay loam, sandy clay loam, or loam in texture. Depth to the C2 horizon is 18 to 22 inches. The lower part of the C horizon is white, light gray or very pale brown in color and is clay loam, sandy clay loam, or loam in texture.

Drake soils, 2 to 5 percent slopes (DrC).—These soils occur as convex, crescent-shaped bands on the eastern and southeastern sides of playas. The areas range from 10 to 40 acres in size. These soils have the profile described as representative for the series. The dunes in which these soils formed were somewhat thinner than those in which the steeper Drake soils formed.

Included with these soils in mapping are some eroded spots along trails and roads in rangeland as well as in some cultivated areas.

Most areas of these soils are in rangeland. Some areas are used for crops. The hazards of soil blowing and water erosion are moderate. Crops that produce large amounts of residue are better suited to these soils than are most other crops. Management needs include management of crop residue on the surface to protect the soil from soil blowing and water erosion. Alfalfa, perennial grasses, or other residue-producing crops help to maintain the soil in good condition. An irrigation system designed to prevent erosion is needed. Terracing and contouring are also needed.

The dominant climax grasses on these soils are side-oats grama, blue grama, and sand dropseed. Overgrazed areas have a thin cover in which sand dropseed and buffalograss are dominant. Invaders include inland saltgrass, sand muhly, and yucca. The total animal production of air-dry herbage on range in excellent condition is 1,100 to 1,800 pounds per acre, depending on variations in rainfall. (Capability unit VIe-2, dryland, and IIIe-5, irrigated; High Lime range site)

Drake soils, 5 to 8 percent slopes (DrD).—These soils are in convex, crescent-shaped areas on the east or leeward side of many of the deeper or larger playas. These areas are less than one-half mile in length and range from 20 acres to about 65 acres in size.

The surface layer is calcareous, grayish-brown loam about 6 inches thick. This is underlain by lavers of limy, light-gray loam. This soil formed in dunes that range from 3 to 20 feet in thickness in some places.

Most of this unit is in rangeland. Slope and the severe hazards of soil blowing and water erosion make these soils unsuitable for cultivation. A few areas contain small gullies caused by rapid runoff.

The dominant climax grasses on these soils are side-oats grama, blue grama, and sand dropseed. Overgrazed areas have thin cover in which sand dropseed and buffalograss are dominant. Invaders include inland saltgrass, sand muhly, and yucca. The total annual production of air-dry herbage on range in excellent condition is 1,100 to 1,800 pounds per acre, depending upon variations in rainfall. (Capability unit VIe-2, dryland; High Lime range site)

Estacado Series

The Estacado series consists of deep, nearly level to gently sloping, calcareous, loamy soils that formed in limy materials.

In a representative profile, the surface, layer is calcareous, dark grayish-brown clay loam about 15 inches thick. The next layer is moderately alkaline, porous, pale-brown clay loam about 10 inches thick that has common worm casts. Below this is about 13 inches of very pale brown clay loam. It is underlain, to a depth of about 80 inches, by reddish-yellow clay loam.

These soils are well drained and moderately permeable. The available water capacity is high.

Representative profile of Estacado clay loam, 1 to 3 percent slopes, 4 miles east of Dimmitt on the south side of State Route 86 in cultivated field (3,700 feet west and 100 feet south of the northeast corner of section 342, block M-6):

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; slightly hard, friable, plastic, slightly sticky; many roots; very fine and fine pores; common worm casts; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—6 to 15 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, subangular blocky and granular structure; very hard, friable, plastic, slightly sticky; many fine roots; many very fine and fine pores and few medium pores; common worm casts; calcareous; moderately alkaline; clear smooth boundary.

B21tca—15 to 25 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; weak, course, prismatic structure parting to moderate, medium, subangular blocky and granular structure; very hard, friable, plastic, slightly sticky; few fine roots; many very fine and fine pores; common worm casts; few fine concretions of calcium carbonate; few clay films; calcareous; moderately alkaline; gradual, smooth boundary.

B22tca—25 to 38 inches, very pale brown (10YR 7/3) clay loam, light yellowish brown (10YR 6/4) moist; weak, medium, subangular blocky structure; slightly hard, friable, plastic, slightly sticky; many very fine and fine pores; 30 percent calcium carbonate concretions; bridged sand grains; calcareous; moderately alkaline; diffuse, wary boundary.

B23tca—38 to 80 inches, reddish-yellow (5YR 7/6) clay loam, reddish yellow (5YR 6/6) moist; weak, medium, subangular structure; hard, friable, plastic, slightly sticky; many very fine and fine pores, mostly root channels; few clay films; few concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 100 inches in thickness. Depth to the zone of maximum calcium carbonate accumulation is 20 to 36 inches. The A horizon ranges from clay loam to loam in texture, from very dark grayish brown and dark grayish brown to grayish brown to brown in color, and from 11 to 20 inches in thickness. The B21tca horizon is grayish brown, pale brown, or light brown in color. In a few places, it is reddish brown or light reddish brown. It is mostly clay loam in texture but ranges to sandy clay loam. The B22tca horizon ranges from very pale brown, light gray and pinkish white to pink. It ranges from 7 to 45 inches in thickness but averages 18 inches. Calcium carbonate content of the B22tca horizon generally ranges from 15 to 50 percent, by volume. In places there are pockets in which the content of carbonates is as high as 60 percent. The B23tca horizon ranges from reddish yellow to brown, light brown, strong brown, light reddish brown, and pink in color.

Estacado clay loam, 0 to 1 percent slopes (EsA).—This soil is on smooth plains. Areas are 20 to 2,000 acres in size. The areas are irregular and are oval to elongated in shape. The slope is dominantly 0.3 to 0.7 percent.

The surface layer is calcareous, dark grayish-brown clay loam about 15 inches thick. The next layer, about 10 inches thick, is calcareous, friable, pale-brown clay loam that has common worm casts. The next lower layer is calcareous, very pale brown clay loam about 13 inches thick. Below this is calcareous, reddish-yellow clay loam that extends to a depth of about 80 inches.

Included with this soil in mapping are small areas of Mansker loam, mostly less than 5 acres in size and small areas of closely associated Posey soils. These type inclusions make up less than 10 percent of this mapping unit. Also included are areas of soils that are noncalcareous in the upper 6 inches and make up about 20 percent of this mapping unit. There are some areas of soils that have a surface layer of loam.

Most of this soil is cultivated. The main crops are small grain, cotton, corn, and sorghums. Some areas remain in rangeland. The hazard of soil blowing is severe, and the hazard of water erosion is slight. Most of the cultivated areas are irrigated. Contour farming, terracing, diversion terraces, and grassed waterways are needed to control erosion. Small grain and sorghums combined with residue-conserving tillage help to control soil blowing and erosion.

If this soil is irrigated management needs include cover produced by using crops such as small grain and sorghums and conserving residue from these crops. Fertilizer is needed to keep the soil in good condition. Irrigation systems need to be so designed and installed that they help to control erosion conserve water, and do not increase inherent soil limitations.

The dominant climax grass on this soil is blue grama, but there are traces of side-oats grama in a few areas. Buffalograss becomes more abundant if a site is over-grazed. The main invaders are three-awn and broom snakeweed. Grazing should be regulated so that a high percentage of blue grama is maintained. The total annual production of air-dry herbage on range in excellent condition is 1,400 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-4, dryland, and IIe-1, irrigated; Deep Hardland range site)

Estacado clay loam, 1 to 3 percent slopes (EsB).—This soil is in slightly convex, oblong bands on side slopes of playa basins and in some places along the draws. Most areas are about 50 acres in size, but they range from 20 to 200 acres in size. Slopes average about 2 percent. This soil has the profile described as representative for the series.

Included with this soil in mapping are areas of Mansker and Posey soils, which are the two main inclusions, and areas of Acuff, Olton, and Pullman soils. Also included, particularly in areas of grass, are areas of soils that are noncalcareous in the upper few inches of the surface layer and areas of soils that are loam in texture and are in association with some of the large areas of Acuff soils.

Most areas of this soil are cultivated. The main crops are small grain and sorghums. A few areas are in range. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. Terraces and contour farming help to control runoff water. Diversion terraces, terraces, and grassed waterways to carry off excess water are needed in places. Management of crop residue on the surface helps to control soil blowing. Most of the cultivated areas of this soil are irrigated.

If this soil is irrigated, fertilizer is needed to keep the soil in good condition. Irrigation systems need to be so designed and installed that they do not increase erosion. Bench leveling or graded borders are used to control erosion and conserve water.

The dominant climax grass on this soil is blue grama, but there are traces of side-oats grama, in a few areas. Buffalograss becomes more abundant if a site is over-grazed. The main invaders are three-awn and broom snakeweed. Grazing should be regulated so that a high percentage of blue grama is maintained. The total annual production of air-dry herbage on range in excellent condition is 1,400 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-2, dryland, and IIIe-2, irrigated; Deep Hardland range site)

Lipan Series

The Lipan series consists of deep, nearly level, calcareous, clayey soils. These soils are on benches of many of the basins and formed in the reworked sediments of the loess mantle.

In a representative profile (fig. 7), the surface layer is clay about 21 inches thick. It is dark gray in the upper 4 inches and gray in the lower part. The next layer is grayish-brown clay about 15 inches thick. Below this is light brownish-gray clay about 18 inches thick. The underlying material, to a depth of about 84 inches, is white, light brownish-gray and light-gray clay that is high in content of lime.

Representative profile of Lipan Clay, 11 miles north and 2 miles east at Dimmitt in rangeland (240 feet west and 400 feet south of the northeast corner of section 38, block M-7.B.S.& F.):

A11—0 to 4 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, medium and fine, blocky and angular blocky structure extremely hard, friable, sticky, plastic; many roots; many fine and very fine pores; few worm casts; very few uncoated sand grains; calcareous, moderately alkaline; clear, smooth boundary.

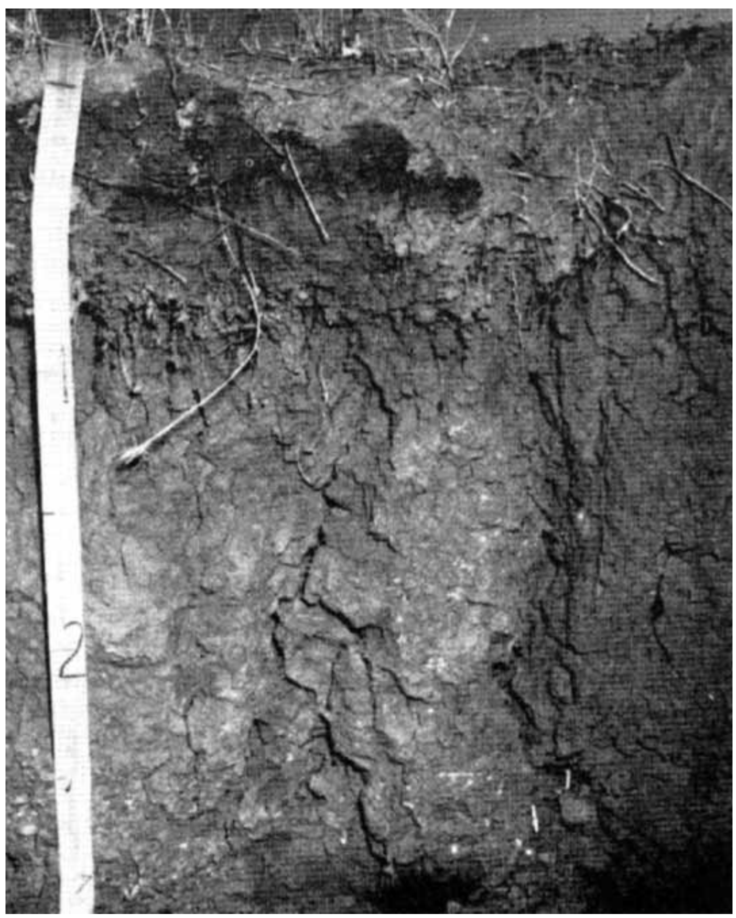


Figure 7.—Profile of Lipan clay. Wide cracks begin in or just below the surface layer and extend deep into the profile.

A12—4 to 21 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate, coarse, blocky structure; extremely hard, firm, sticky, plastic; many roots; many fine and very fine pores; slickensides 1 to 3 inches in length; shiny pressure faces; some grooving, indicating slippage planes, particularly on horizontal ped surfaces; few very fine concretions of calcium carbonate few snail shells; very few uncoated sand grains; calcareous; moderately alkaline; gradual, smooth boundary.

AC1—21 to 36 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak, medium, blocky structure; extremely hard, firm, sticky, plastic; parallelepipeds or wedge-shaped peds 1/4 to 1/2, inch long; grooved slickensides; shiny pressure faces; very few uncoated sand grains; many very fine and fine pores; few fine concretions of calcium carbonate; few snail shells; calcareous; moderately alkaline; gradual, smooth boundary.

AC2—36 to 54 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; weak, medium, blocky and subangular blocky structure; very hard, firm, sticky, plastic; many very fine and fine pores; shiny pressure faces; some grooving on horizontal ped surfaces; very few uncoated sand grains; few fine concretions of calcium carbonate; few snail shells; calcareous; moderately alkaline; gradual, smooth boundary.

C1ca—54 to 76 inches, about equal amounts of white (10YR 8/2);and light brownish-gray (10YR 6/2) clay, very pale brown (10YR 7/3) and grayish brown (10YR 5/2) moist; weak, medium, blocky structure; very hard, firm, sticky, plastic; many very fine and some fine pores; shiny pressure faces; slight evidence of grooving, very few uncoated sand grains; few fine concretions of calcium carbonate; few snail shells; calcareous; moderately alkaline; diffuse, smooth boundary.

C2—76 to 84 inches, light-gray (2.5Y 7/2) clay, light brownish gray (2.5Y 6/2) moist; weak, fine, blocky and angular blocky structure; very hard, firm, sticky, plastic; calcareous; moderately alkaline.

The A horizon ranges from 13 to 35 inches in thickness and is mildly alkaline to moderately alkaline. The part of the profile that has the most distinct grooved intersecting slickensides and parallelepipeds is between depths of 15 and 40 inches. The AC horizon has moderate, blocky to weak, blocky structure in the more clayey profiles. The depth to the C1ca horizon ranges from 40 to 80 inches. The C2 horizon consists of calcareous white, light-gray, or pale-brown clay.

Lipan clay (Lc).—This nearly level soil is in slightly concave, crescent-shaped areas ranging from 20 acres to about 125 acres in size. Areas are typically in grass and have a slight gilgai microrelief. Gilgai relief consists of knolls 3 to 8 feet in diameter and depressions 3 to 8 inches below the crest of the microhighs.

Included with this soil in mapping are some areas of slightly less clayey, dark-gray soils that have secondary calcium carbonate enrichments at a depth of 40 inches or more. Also included are some areas of soils that have dark-gray clay about 13 inches thick over lower layers that are similar to those in the profile described as representative for the series. Also included are small areas of Lofton and Estacado soils and some areas of Lipan clay having slopes of 1 to 2 percent. These areas are generally on the rims of playas.

About half of this soil is cultivated, and about half is used for native rangeland. The principal crops are small grain and sorghums. The hazard of soil blowing is moderate. The hazard of water erosion is slight. During years of high rainfall, areas of Lipan soils along playa basins are inundated for several weeks in places.

Managing crop residue on the surface helps to control soil blowing and maintain soil condition. The surface layer is hard when it is dry, and it tends to clod if tilled. The clayey lower layers are compact and hard to plow. They are extremely hard when dry and sticky when wet.

If this soil is irrigated, the use of fertilizer and the return of large amounts of crop residue are needed. Irrigation systems should be so designed and installed that they do not increase inherent soil limitations. A recovery system for runoff irrigation water is commonly needed. Grassed waterways and diversion terraces to safely carry off excess water are needed in places.

The dominant climax grass on this soil is buffalograss, but there is some vine-mesquite in places. Other important grasses are blue grama, western wheatgrass, and inland saltgrass. Buffalograss becomes more abundant if a site is overgrazed. Grazing should be regulated so that a high percentage of vine-mesquite is maintained. Most areas of range on this soil are kept in good condition. The total annual production of air-dry herbage on range in excellent condition is 0 to 4,000 pounds per acre, depending on variations in rainfall and periods of inundation. (Capability unit IVs-1, dryland, and IVs-1, irrigated; Deep Hardland range site)

Lofton Series

The Lofton series consists of deep, nearly level, noncalcareous, loamy soils. These soils are in the large basins on level benches, 3 to 10 feet above playas, and formed in materials of the loess mantle.

In a representative profile, the surface layer is clay loam 9 inches thick. It is dark brown in the upper part and dark gray below. The next layer is dark grayish-brown, very firm clay 12 inches thick. Below this is calcareous, grayish-brown clay about 23 inches thick. Below a depth of 44 inches is white clay loam that contains about 60 percent lime.

These soils are moderately well drained and very slowly permeable. The available water capacity is high, and run off is slow to ponded.

Representative profile of Lofton clay loam, 3.5 miles east and 2.5 miles south of Arney (1,500 feet north and 500 feet west of the southwest corner of section 150, block M-6):

A11 —0 to 3 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; strong, coarse and medium, subangular blocky and granular structure; very hard, friable, sticky, plastic; many roots, about half are flattened along ped surfaces; many fine and very fine pores and few medium pores; neutral; abrupt, smooth boundary.

A12—3 to 9 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; strong, coarse and medium, subangular blocky and granular structure; extremely hard, firm, sticky, plastic; many roots, about half are flattened along ped surfaces; many fine and very fine pores and few medium pores; neutral; abrupt, smooth boundary.

B21t—9 to 21 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong, medium, blocky structure, blocks arranged in thick wedges; extremely hard, very firm, sticky, plastic few fine or very fine pores; many roots, most are flattened on ped surfaces; many clay films; some slight pressure faces; mildly alkaline; gradual, smooth boundary.

B22t—21 to 29 inches, grayish-brown (10YR 5/2) clay dark grayish brown (10YR 4/2) moist; moderate, medium, blocky structure, axis of horizontal pods about one-third longer than vertical axis; extremely hard, very firm, sticky, plastic; many roots, most are flattened along ped surfaces; many clay films; few, fine, soft, calcium carbonate masses; calcareous; moderately alkaline; gradual, smooth boundary.

B23t—29 to 44 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate, medium, blocky and subangular blocky structure; very hard, firm, sticky, plastic; few fine roots growing through peds; common fine and very fine pores, mostly root channels; few clay films; many, fine, soft, gray masses of calcium carbonate; few medium concretions of calcium carbonate in lower part; few threads of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

B24tca—44 to 80 inches, white (10YR 8/1) clay loam, light gray (10YR 7/2) moist; weak, fine, subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; many very fine and fine pores and few medium pores, all of which are mostly root channels; 60 percent calcium carbonate, by volume; calcareous; moderately alkaline.

The A1 horizon ranges from 6 to 10 inches in thickness and from dark brown and dark grayish brown to dark gray in color. The B21t and B22t horizons range from 20 to 35 inches in thickness, and they are the most clayey part of the profile. These horizons have cracks 1/2 inch to 1 inch wide and from 12 to 15 inches long. The greatest amount of cracking is from a depth of about 16 to 30 inches. The B24tca horizon ranges from white and very pale brown to dark grayish brown in color.

Lofton clay loam (Lo).—This soil is on benches in basins. Areas range from 12 to 100 acres in size. Randall and Lipan soils occur in areas below this soil.

Included with this soil in mapping are small potholes of Randall soils and areas a few acres in size of soils similar to this Lofton soil but that have clay loam lower layers. Also included in areas adjoining Estacado or Pullman soils are soils similar to this Lofton soil, except that in some areas the lower layers are reddish-brown or yellowish-red clay loam or sandy clay loam and in a few areas the soils are calcareous to the surface.

Most of this soil is cultivated. It is well suited to dry-farming. The principal crops are small grain and sorghums. Some areas are in native range. Some soil blowing has occurred in all areas that have been cultivated, and it is a moderate hazard. In a few areas, water flowing onto Lofton soils from adjoining areas causes flooding or washing out of crops. During years of high rainfall, areas of Lofton soils along playa basins are inundated for several weeks in places. Water erosion is a slight hazard. The management of crop residue on the surface helps to control soil blowing and erosion and keeps the soil in good condition.

If this soil is irrigated, the return of a large amount of crop residue to the soil and the application of commercial fertilizer, in amounts based on soil and crop requirements, are needed in places. Irrigation systems need to be so designed and installed that they do not increase inherent limitations. Runoff from surrounding areas should be diverted.

The native vegetation on this soil consists mainly of blue grama and buffalograss. Buffalograss becomes more abundant if a site is overgrazed. Grazing should be regulated so that a high percentage of blue grama is maintained. Most areas of range on this soil are kept in good condition. The total annual production of air-dry herbage on range in excellent condition is 1,000 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-3, dryland, and IIs-1, irrigated; Deep Hardland range site)

Mansker Series

The Mansker series consists of deep, gently sloping to sloping, calcareous, loamy soils. These soils formed in limy materials of the eolian mantle. In Castro County, Mansker soils were mapped only in complexes with Estacado and Berda soils.

In a representative profile, the surface layer is dark grayish-brown loam about 9 inches thick that contains a few concretions of lime. The next layer is friable, brown clay loam about 6 inches thick. Below this is calcareous, friable, reddish-yellow clay loam that contains 40 percent lime concretions, by volume. It is about 5 inches thick. The next layer is light-brown clay loam about 9 inches thick. It is underlain, to a depth of about 83 inches, by reddish-yellow clay loam.

Mansker soils are well drained and moderately permeable. The available water capacity is high, and runoff is medium to rapid.

Representative profile of a Mansker loam, in an area of Mansker-Estacado loams, 3 to 5 percent slopes, 2 miles south and 2.5 miles east of Sunnyside in rangeland (1,500 feet south and 300 feet west of the northwest corner of section 31, block 1, W.E.H. survey):

A1—0 to 9 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse and medium, subangular blocky and granular structure; slightly hard, friable, slightly plastic; few worm casts near the surface and many worm casts at the bottom of the horizon; few fine and medium concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B21ca—9 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure, and weak, medium, subangular blocky and granular structure; hard, friable, plastic; most granules are partly decomposed worm casts; few soft calcium carbonate masses; few medium concretions of calcium carbonate; many worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B22ca—15 to 20 inches, reddish-yellow (5YR 6/5) clay loam, yellowish red (5YR 4/5) moist; weak, medium, subangular blocky structure; hard, friable, plastic; few worm casts; 40 percent fine to coarse, laminated, calcium carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

B23ea—20 to 29 inches, light-brown (7.5YR 6/3) clay loam, brown (7.5YR 5/3) moist; weak, coarse, subangular blocky structure; hard, friable; porous; few worm casts; 10 percent fine to medium calcium carbonate concretions and films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B24tca—29 to 83 inches, reddish-yellow (5YR 7/5) clay loam, yellowish red (5YR 5/5) moist; weak, medium, subangular blocky structure; very hard, friable; few clay films; 40 to 60 percent calcium carbonate concretions; calcareous; moderately alkaline.

The A horizon ranges from 7 to 12 inches in thickness and from dark grayish brown to brown in color. The B21ca horizon is mainly clay loam in texture but ranges to sandy clay loam. It is grayish brown or brown to dark brown in color. The B21ca horizon ranges from a few inches to 8 inches in thickness. Typically, the B21ca horizon contains more than 50 percent worm casts. The more clayey profiles contain fewer worm casts, ranging to as few as about 25 percent. Depth to the B22ca horizon ranges from 10 to 18 inches. The B22ca horizon ranges in total lime from 25 to 70 percent and in visible segregated lime from 8 to 50 percent. The B22ca and B23ca horizons range from a few inches to several feet in thickness. The B24tca horizon ranges from pink or light reddish brown to reddish yellow. The B24tca horizon is calcareous clay loam, sandy clay loam, or loam that contains less calcium carbonate than the overlying B22ca and B23ca horizons.

Mansker-Berda loams, 5 to 8 percent slopes (MbD).— Areas of this complex range from 15 to 300 acres in size, but the average area is about 100 acres in size. The soils of this complex occupy foot slopes below Olton, Estacado, and Pullman soils and above Bippus and Spur soils that are on old flood plains. The Mansker soil occupies the convex upper half of the foot slopes, and the Berda soil occupies the lower, slightly concave part of the slopes. The Mansker soil makes up about 50 percent of the complex; the Berda soil, about 40 percent; and included soils, about 10 percent.

Included with these soils in mapping are areas of Estacado, Potter, and Bippus soils. Also included are small areas of Acuff and Olton soils.

The Mansker soil has a surface layer of dark grayish-brown loam about 9 inches thick. The next layer is grayish-brown clay loam about 6 inches thick. Below this is reddish-yellow clay loam that contains about 50 percent calcium carbonate concretions and is about 10 inches thick. The next layer, to a depth of 80 inches, is pink clay loam. The Berda soil has a surface layer of dark grayish brown loam about 9 inches thick. The next layer is light-brown loam about 18 inches thick. Below this is pale-brown loam about 19 inches thick. The underlying material, to a depth of 60 inches, is brown loam.

Most areas of these soils are used for range. They are not suited to cultivation. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. Runoff is medium. A few small areas of these soils are in irrigated pasture. Irrigation systems need to be so designed and installed that they do not increase the inherent soil limitations. Pastures need grazing management, fertilization, frequent irrigation, and rotation grazing for good results.

The dominant climax grasses on these soils are blue grama and side-oats grama. Buffalograss replaces side-oats grama if a site is overgrazed. The principal invaders are prickly pear, yucca, and broom snakeweed. The total annual production of air-dry herbage on range in excellent condition is 1,200 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit VIe-1, dryland; Hardland Slopes range site)

Mansker-Estacado loam, 3 to 5 percent slopes (MeC).—This complex occurs as long areas, 400 to 800 feet wide, that follow the contours of playa basins and draws. The areas range from 15 to 100 acres in size. The Mansker soil occupies the convex upper half of the longer slopes or the convex central part of the shorter slopes. The Estacado soil occupies the less convex to slightly concave slopes below the Mansker soil and is above and below areas of the Mansker soil that have short slopes. The Mansker soil makes up 50 percent of this complex; the Estacado soil, 35 percent; and included soils, 15 percent.

Included with these soils in mapping are areas of Bippus, Olton, and Posey soils.

The Mansker soil has the profile described as representative for the series. The Estacado soil has a surface layer of dark grayish-brown loam about 12 inches thick. The next layer is pale-brown clay loam about 12 inches thick. Below a depth of 24 inches, and extending to a depth of 40 inches, is pink clay loam that is high in content of carbonates. Below a depth of 40 inches is reddish-yellow clay loam that extends to a depth of 80 inches.

Most areas of these soils are used for range. A few small areas are used for irrigated pasture or are farmed along with large areas of other soils. The hazards of soil blowing and water erosion are moderate. Management needs include use of crop residue on the surface to help control soil blowing and erosion and use of terraces, diversion terraces, contour farming, and grassed waterways. An irrigation system needs to be so designed and installed that it does not increase inherent soil limitations. Pastures need grazing management, fertilization, frequent irrigation, and rotation grazing for good results.

The dominant climax grasses on these soils are side-oats grama and blue grama. Buffalograss replaces side-oats grama if a site is overgrazed. Response to management is good. The main invaders are yucca and broom snakeweed. The total annual production of air-dry herbage on range in excellent condition is 1,200 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IVe-4, dryland, and IVe-2, irrigated; Hardland Slopes range site)

Olton Series

The Olton series consists of deep, nearly level to gently sloping, noncalcareous, loamy soils. These soils formed in clay and sandy clay loam materials of the eolian mantle.

In a representative profile (fig. 8), the surface layer is dark-brown clay loam about 9 inches thick. The next layer is reddish-brown clay loam about 30 inches thick. Below this is calcareous, pink clay loam about 22 inches thick. This is underlain by light reddish-brown and reddish-yellow clay loam to a depth of about 80 inches.

Olton soils are well drained and moderately slowly permeable. The available water capacity is high, and runoff is very slow to slow.

Representative profile of Olton clay loam, 0 to 1 percent slopes, 3.4 miles north and 0.3 mile west of Dodd (1,400 feet west and 150 feet north of the southeast corner of section 11, block T, R.M.T. survey):

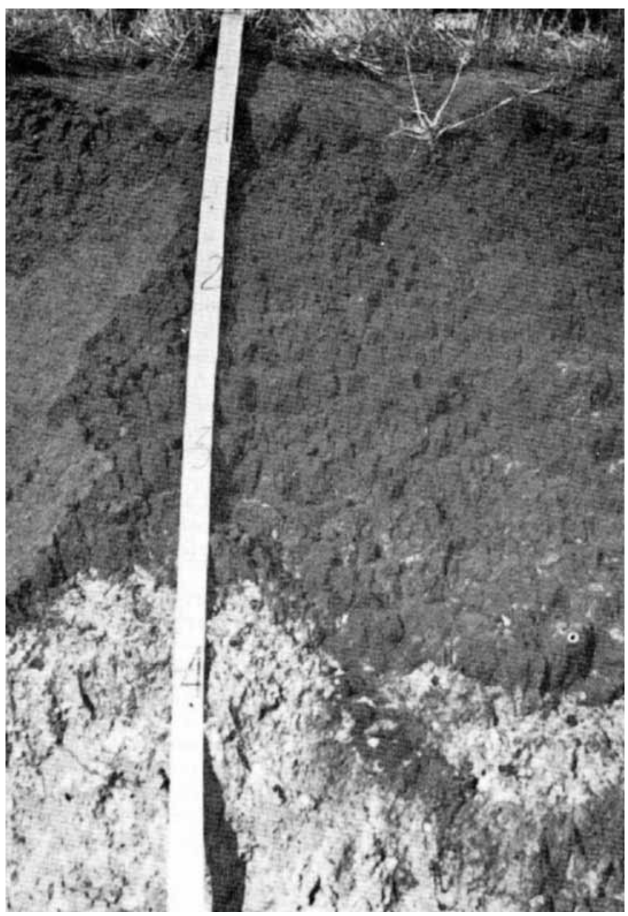


Figure 8.—Profile of an Olton day loam. The layer of calcium carbonate accumulation begins at a depth of about 39 inches.

Ap—0 to 9 inches, dark-brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/3) moist; weak, coarse, subangular blocky and granular structure; slightly hard, friable, plastic; neutral; abrupt, smooth boundary.

B21t—9 to 13 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate, coarse and medium, subangular blocky structure parting to medium and fine, subangular blocky structure; hard, friable, slightly sticky, plastic; few worm casts; few clay films; mildly alkaline; clear, smooth boundary.

B22t—13 to 18 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate, medium, blocky structure and some subangular blocky structure; very hard, firm, sticky, plastic; very few worm casts; common clay films; mildly alkaline; wavy to smooth boundary.

B23t—18 to 39 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate, medium, subangular blocky structure; hard, firm in upper part, and friable in lower part, slightly sticky, plastic; few clay films; few, fine, cemented concretions of calcium carbonate; few, fine, soft masses of calcium carbonate; some films; and threads of calcium carbonate, mostly at the bottom of the horizon; patches of noncalcareous soil in upper part, rest calcareous; moderately alkaline; clear, wavy boundary.

B24tca—39 to 61 inches, pink (5YR 8/3) clay loam, pink (5YR 7/4) moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky, plastic; porous; many old root channels; 60 percent by volume of white calcium carbonate masses, about 30 percent in lower part of horizon; calcareous; moderately alkaline; diffuse, wavy boundary.

B25t—61 to 72 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 5/5) moist; weak, medium, subangular blocky structure; hard, friable; porous, pores appear to be old root channels; clay-bridged sand grains; common soft lumps and concretions of calcium carbonate; some threads and common films of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

B26t—72 to 80 inches, reddish-yellow (5YR 7/5) clay loam, yellowish red (5YR 5/5) moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky, plastic; porous; few clay films; clay-bridged sand grains; soft lumps and concretions of calcium carbonate; few threads and films of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 7 to 12 inches in thickness and is brown, dark brown, or reddish brown in color. The B21t horizon is 4 to 11 inches thick and is mainly reddish brown but ranges to dark reddish gray or reddish gray in color. The B22t horizon is mainly clay loam but ranges to clay (35 to 45 percent clay). The B24tca horizon is heavily enriched with calcium carbonate, ranging from 30 to 60 percent carbonate, by volume. It is at a depth of 30 to 60 inches. The B25t and B26t horizons are reddish brown, light reddish brown, yellowish red and reddish yellow in color. Carbonates in these horizons range from threads or a thin, soft coating on macrostructure faces to vertical stringers containing cemented nodular concretions.

Olton clay loam, 0 to 1 percent slopes (OIA).—This soil is on smooth plains. Areas are 20 acres to hundreds of acres in size and are surrounded by Pullman soils. Most large areas of Olton soils contain oval areas of Estacado and Acuff soils. Slope is generally less than 0.5 percent. This soil has the profile described as representative for the series.

Included with this soil in mapping are areas, 5 acres or less in size, of Estacado, Mansker, and Acuff soils. Also included are areas of soils that have been cultivated for several years and generally have had some of the fine soil material removed from the surface layer, resulting in a more loamy texture. Some of these areas occur where this Olton soil is closely associated with Acuff soils.

Most areas of this soil are irrigated. Grain sorghum, wheat, and sugar beets are the main crops (fig. 9). Castor beans and vegetables are also grown. The hazards of soil blowing and water erosion are slight.

Figure 9.—Sugar beets grown under irrigation on Olton clay loam, 0 to 1 percent slopes.

If this soil is irrigated, management needs include fertilization, use of crop residue, rotation of crops, and management of irrigation water in a properly designed irrigation system. Runoff is very slow.

If this soil is dryfarmed, management should include maintaining an adequate amount of crop residue on the surface to protect it from soil blowing.

The dominant climax grass on this soil is blue grama, but traces of side-oats grama are in a few areas, Buffalograss becomes more abundant if a site is overgrazed. The main invaders are three-awn and broom snakeweed, Grazing should be regulated so that a high percentage of blue grama is maintained. Most areas of range, on this soil are kept in good condition. The total annual production of air-dry herbage on range in excellent condition is 1,300 to 2,100 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-4, dryland, and IIe-1, irrigated; Deep Hardland range site)

Olton clay loam, 1 to 3 percent slopes (OlB).—This soil is generally around playas and along draws, but some areas are on low ridges above the main level of the plains. The areas range from about 20 to 100 acres in size. Slope is dominantly about 2 percent.

This soil has a surface layer of brown clay loam 8 inches thick. The next layer, extending to a depth of 36 inches, is reddish-brown clay loam. Between depths of 36 and 55 inches is pink clay loam that is high, in content of carbonates. Below a depth of 55 inches is reddish-yellow clay loam.

Included with this soil in mapping are small areas of Estacado and Acuff soils. Also included are some areas of soils that have a loam surface layer.

Most areas of this soil are used for crops. Most of the cropland is irrigated. A few areas are used for native rangeland. The principal crops are small grain and sorghums. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Runoff is slow.

If this soil is irrigated, management needs include fertilization, use of crop residue, rotation of crops, and management of irrigation water in a properly designed irrigation system.

If this soil is dryfarmed, management includes use of terracing, contouring, and, in places, diversion terraces and grassed waterways.

The dominant climax grass on this soil is blue grama, but traces of side-oats grama are in a few areas. Buffalogass becomes more abundant if a site is overgrazed. The main invaders are three-awn and broom snakeweed. Grazing should be regulated so that a high percentage of blue grama is maintained. Most areas of range on this soil are kept in good condition. The total annual production of air-dry herbage on range in excellent condition is 1,300 to 2,100 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-2, dryland, and IIIe-2, irrigated; Deep Hardland range site)

Olton clay loam, 3 to 5 percent slopes (OlC). —This soil is in smooth, slightly convex bands adjoining draws and playa basins. Most areas range from 10 to 25 acres in size.

This soil has a surface layer of brown clay loam 8 inches thick. The next layer is reddish-brown clay loam that extends to a depth of about 31 inches. Below a depth of 34 inches and extended to a depth of 56 inches is pink clay loam. Below a depth of 56 inches and extending to a depth of 80 inches is reddish-yellow clay loam.

Included with this soil in mapping are small areas of Estacado, Posey, and Acuff soils. A few eroded areas are also included.

Most of this soil is used as rangeland. This soil can be used for cropland without erosion occurring if intensive management is used. The hazard of water erosion is severe. The hazard of soil blowing is slight.

The dominant climax grass is blue grama, but traces of side-oats grama are in a few areas. Buffalograss becomes more abundant if a site is overgrazed. The main invaders are the three-awn and broom snakeweed. Grazing should be regulated so that a high percentage of blue grama is maintained. The total annual production of air-dry herbage on range in excellent condition is 1,300 to 2,100 pounds per acre, depending on variations in rainfall. (Capability unit IVe-1, dryland, and IIIe-3, irrigated; Deep Hardland range site)

Posey Series

The Posey series consists of deep, nearly level to gently sloping, calcareous, loamy soils. These soils formed in limy materials of the eolian mantle.

In a representative profile (fig. 10), the surface layer is calcareous, brown loam about 9 inches thick. Below this is light-brown clay loam about 6 inches thick. The next layer is pink clay loam about 50 inches thick. Below this, to a depth of 85 inches, is reddish-yellow clay loam.

The Posey soils are well drained and moderately permeable. The available water capacity is high, and runoff is medium.

Representative profile of a Posey loam, in an area of Posey complex, 1 to 3 percent slopes, 10 miles west and 5 miles north of Dimmitt in cultivated field (1,550 feet west and 3,100 feet south of the northeast corner of section 2, S. S. Evants):

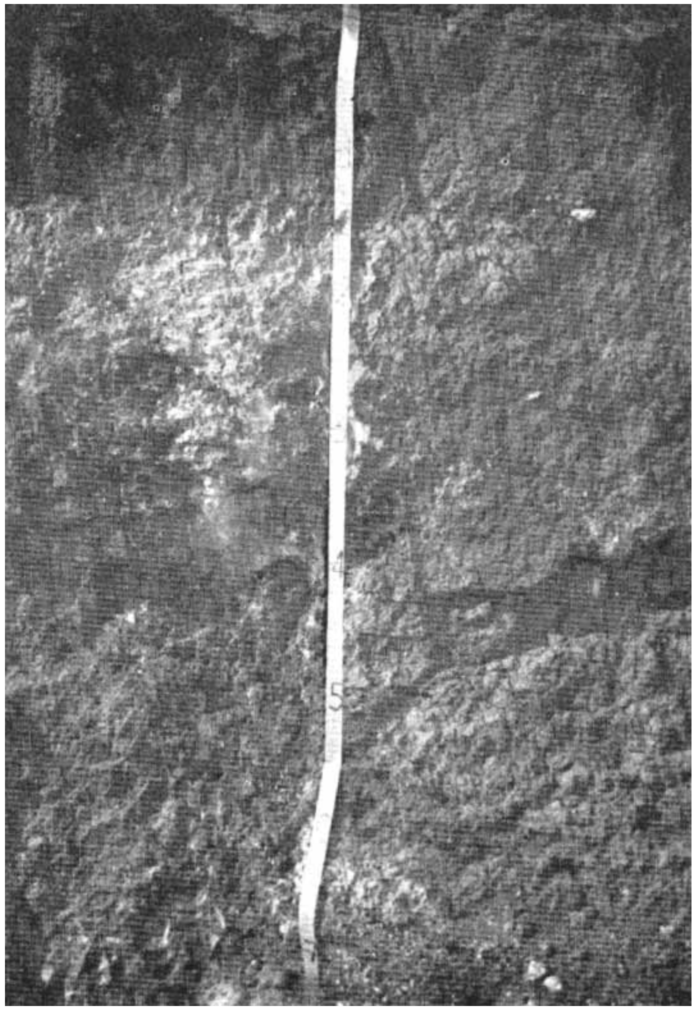


Figure 10. Profile of a Posey loam. Calcium carbonate accumulation is very near the surface.

Ap—0 to 9 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; slightly hard, very friable; few decaying roots; many very fine and fine pores; few caliche pebbles on surface and in soil; calcareous; moderately alkaline; abrupt, smooth boundary.

B21tca—9 to 15 inches, light-brown (7.5YR 6/3) clay loam, brown (7.5YR 5/3) moist; weak to moderate, coarse, prismatic structure parting to weak, subangular blocky and granular structure; slightly hard, friable; few decaying roots; many very fine and fine pores; few fine concretions of calcium carbonate; many worm casts; few clay films; calcareous, moderately alkaline; clear, smooth boundary.

B22tca—15 to 25 inches pink (7.5YR 7/4) clay loam, reddish yellow (7.5YR 6/5) of moist; weak to moderate, coarse, prismatic structure parting to weak, subangular blocky and granular structure; slightly hard, friable; few clay films; many very fine and fine pores; about 25 percent soft lumps and concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B23tca—25 to 49 inches, pink (7.5YR 8/4) clay loam, reddish yellow (7.5YR 7/5) moist; weak, medium, subangular blocky structure; hard, friable; few clay films; many very fine and fine pores; about 40 percent soft lumps and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B24tca—49 to 65 inches, pink (5YR 8/4) clay loam, reddish yellow (5YR 7/6) moist; weak, medium, subangular blocky structure; very hard, friable; few clay films; many very fine and fine pores; about 25 percent soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B25tca—65 to 85 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak, medium, subangular blocky structure; hard, friable; few clay films; mass is made up of bridged sand grains; about 5 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 6 to 10 inches in thickness and from grayish brown to brown in color. It is loam, sandy clay loam or fine sandy loam in texture. The B21tca horizon is mainly clay loam in texture but ranges to sandy clay loam. The B21tca horizon ranges from light brown to brown, pale brown, or yellowish brown in color and from 5 to 13 inches in thickness. Depth to the B22tca horizon ranges from 12 inches to about 23 inches. The B22tca, B23tca, and B24tca horizons range in content of lime from 25 percent to about 80 percent by volume and in visible segregated lime from 8 to 50 percent, by volume. The B25tca horizon ranges from pink or light reddish brown to reddish yellow and yellowish red in color.

Posey complex, 0 to 1 percent slopes (PoA).—These soils are on plains in slightly convex, irregular areas that are within larger areas of Estacado soils. The average area is about 15 acres in size. Posey soils make up about 75 percent of the complex; the other soil in this complex makes up about 20 percent and is similar to Posey soils, except that it has no clay accumulation within a depth of 20 inches.

Included in mapping are areas of Estacado and Potter soils. These soils make up the remaining 5 percent of the complex.

The Posey soil has a surface layer of calcareous, brown loam about 7 inches thick. The next layer is light-brown clay loam about 8 inches thick. Below this is pink clay loam about 53 inches thick. Below this, to a depth of about 80 inches, is reddish-yellow clay loam.

Most areas of this complex are cultivated. About equal amounts are irrigated and dryfarmed. The main crops are small grain and sorghums. Soil blowing is a severe hazard. The hazard of water erosion is slight. Management of crop residue, on the surface helps to control soil blowing and maintain soil condition. Diversion terraces, terraces, and grassed waterways to carry off excess water are needed in places.

If these soils are irrigated, management needs include use of irrigation water in a properly designed irrigation system, use of crop residue, rotation of crops, and fertilization.

The dominant climax grass on these soils is blue grama. There are also moderate amounts of side-oats grama. Buffalograss replaces side-oats grama if a site is overgrazed. The total annual production of air-dry herbage on range in excellent condition is 1,400 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IVe-2, dryland, and IIIe-4, irrigated; Hardland Slopes range site)

Posey complex, 1 to 3 percent slopes (PoB).—These soils have smooth slopes and are around playa basins and along draws throughout the county. Areas range from 8 to 65 acres in size, but they are mainly about 25 acres. These soils are below Pullman, Olton, and Estacado soils that are on level plains, and they are mainly in association with Estacado soils.

Posey soils make up about 75 percent of the complex. They have the profile described as representative for the series. The other soil makes up about 20 percent and is very similar to Posey soils, except that it has no clay accumulation within a depth of 20 inches.

Included with this complex in mapping are areas of Estacado and Potter soils. These soils make up the remaining 5 percent of the complex.

Most areas of this complex are cultivated with adjoining soils. The main crops are small grain and sorghums. The main concern of management is controlling soil blowing and water erosion. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. Crop residue managed on the surface helps to control soil blowing. Water erosion can be controlled by terraces or benches and contour farming. Diversion terraces and grassed waterways are needed in places.

If this soil is irrigated, management needs include fertilization, crop rotation, use of crop residue, and management of irrigation water in a properly designed irrigation system.

The dominant climax grasses on these soils are side-oats grama and blue grama. Buffalograss replaces side-oats grama if the site is overgrazed. The principal invaders are pricklypear and broom snakeweed. The total annual production of air-dry herbage on range in excellent condition is 1,400 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IVe-2, dryland, and IIIe-4, irrigated; Hardland Slopes range site)

Potter Series

The Potter series consists of gently sloping to sloping, calcareous, loamy soils that are very shallow over slightly platy caliche. These soils occur as knobs or knolls that protrude from the sloping sides of draws. They formed in limy material of the Ogallala Formation.

In a representative profile (fig. 11), the surface layer consists of brown loam, about 9 inches thick, that contains a few caliche fragments. The next layer is white, slightly platy caliche about 5 inches thick. Below this, to a depth of about 50 inches, is very pale brown, slightly platy caliche.

The Potter soils are well drained and moderately permeable. Runoff is medium to rapid, and the available water capacity is low.

Representative profile of a Potter loam in an area of Potter soils, 1 mile west and 5 miles north of Dodd (1,100 feet north and 15 feet west of the southeast corner of section 21, R.M. Thompson, block T):

A1—0 to 9 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, coarse and medium, subangular blocky structure; slightly hard, friable, slightly plastic; many roots; many fine and very fine pores and few medium pores, many of which are root channels; many, fine, indurated, calcium carbonate concretions; few fragments of indurated caliche on surface; fragments are up to 5 centimeters in size; calcium carbonate concretions and fragments have a knobby lower surface, a microsmooth upper surface, and a very fine, porous interior; calcareous; moderately alkaline; abrupt, smooth to irregular boundary.

C1ca—9 to 14 inches, white (10YR 8/2), slightly platy caliche (has a hardness of slightly less than 3 on the Mohs scale, but it can be cut with a spade); plates are fractured; lower surfaces of plates have pendants of calcium carbonate that are about ¼ inch long, upper surfaces of plates are microsmooth; the tops of the uppermost plates are smoother than those of the underlying plates; thin layers of loam and few roots between plates; some darkened organic film coats on plate surfaces; plates have very fine, porous interiors; calcareous; moderately alkaline; clear, smooth boundary.

C2—14 to 50 inches, very pale brown (10YR 8/3), a slightly platy caliche in upper part (top has a hardness of less than 3 on the Mohs scale, but it can be cut with a spade); plates are less evident with depth; massive; caliche is very porous throughout; an increasing amount of reddish-yellow soil is mixed with the caliche at the bottom of the horizon; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness and is brown, grayish brown, light brownish gray, or light brown in color. Its content of caliche pebbles and fragments is 15 to 35 percent by volume. The C1ca horizon is 50 to 95 percent pink to white, soft masses to cemented, platy fragments of calcium carbonate intermixed with calcareous loam to clay loam. The C2 horizon ranges from slightly platy, cemented caliche to soft caliche. The lower part of the C2 horizon, beginning at a depth of about 3 feet, is 60 to 80 percent or more light-brown to reddish-yellow or yellowish-red loam and clay loam, and the remaining percentage is soft, white lumps and cemented concretions of calcium carbonate. In some places the substratum is a thick bed of cemented caliche, mostly having more than 60 percent; strongly cemented to indurated, laminated caliche plates and stones. In places this material is 10 feet thick or more.

Figure 11.—Profile of a Potter soil.

Potter soils (Pt).—These gently sloping to sloping soils occupy the upper parts of knolls and the sides of draws. Most areas range from 10 to 25 acres in size.

Included with these soils in mapping are small areas of Mansker soils, some small spots of barren caliche outcrops, and areas of Berda soils. Also included are some areas of Potter soils that have a dark grayish-brown surface layer and a few spots of soils that contain from 35 to 50 percent caliche pebbles and fragments, by volume.

Potter soils are used mostly for grazing. They are not suited to cultivation. Where the caliche beds are thick enough, these soils are a source of caliche that is fairly near the surface. Limitations are few for open-pit mining. Caliche is mined in a few areas and used locally for road-bed material. The cover of grass is generally thin.

On range in good or excellent condition, side oats grama, blue grama, hairy grama, and little bluestem are the dominant climax grasses. Careful management is needed to maintain a cover that is dense enough to control erosion. The total annual production of air-dry herbage from range in excellent condition is 400 and 800 pounds per acre, depending on variations in rainfall. (Capability unit VIIs-1, dryland; Very Shallow range site)

Pullman Series

The Pullman series consists of deep, smooth, nearly level to gently sloping, noncalcareous, loamy soils. These soils are in broad areas of tableland. They formed in fine-textured materials of the eolian mantle.

In a representative profile (fig. 12) the surface layer is dark-brown clay loam about 8 inches thick. The next layer is dark-brown and brown clay about 22 inches thick. Below this is about 16 inches of yellowish-red clay. The next layer, about 26 inches thick, is pink silty clay loam. It is underlain, to a depth of about 84 inches, by reddish-yellow silty clay loam.

The Pullman soils are well drained and are very slowly permeable. The available water capacity is high, and runoff is slow.

Representative profile of Pullman clay loam, 0 to 1 percent slopes, 0.4 mile north of Arney (2,400 feet north and 300 feet west of the southeast corner of section 233, block M-6, SK and K survey):

Ap—0 to 8 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; slightly hard, very friable slightly sticky, plastic; many fine roots; many fine and very fine pores and few medium pores; neutral; abrupt, smooth boundary.

B21t—8 to 12 inches, dark-brown (7.5YR 4/3) clay, dark brown (7.5YR 3/3) moist; weak, coarse, subangular blocky structure parting to moderate, medium, blocky structure; very hard, firm, sticky, plastic; many roots, about half penetrate peds; few fine pores; few clay films; neutral; clear, smooth boundary.

B22t—12 to 21 inches, dark-brown (7.5YR 4/3) clay, dark brown (7.5YR 3/3) moist; moderate, medium and fine, blocky structure, lower part of horizon has blocks arranged in ¼-inch thick wedges that taper to 1/8-inch or less; extremely hard, very firm, sticky, plastic; most roots are flattened between peds and roots; clay films on peds; mildly alkaline; clear, smooth boundary.

B23t—21 to 30 inches, brown (7.5YR 5/3) clay, brown (7.5YR 4/3) moist; moderate, medium and fine, blocky structure, lower part is nearly all moderate, medium, blocky and upper part of horizon has blocks arranged in ¼-inch thick wedges that taper to 1/8-inch or less; very hard, firm, sticky, plastic; few clay films; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

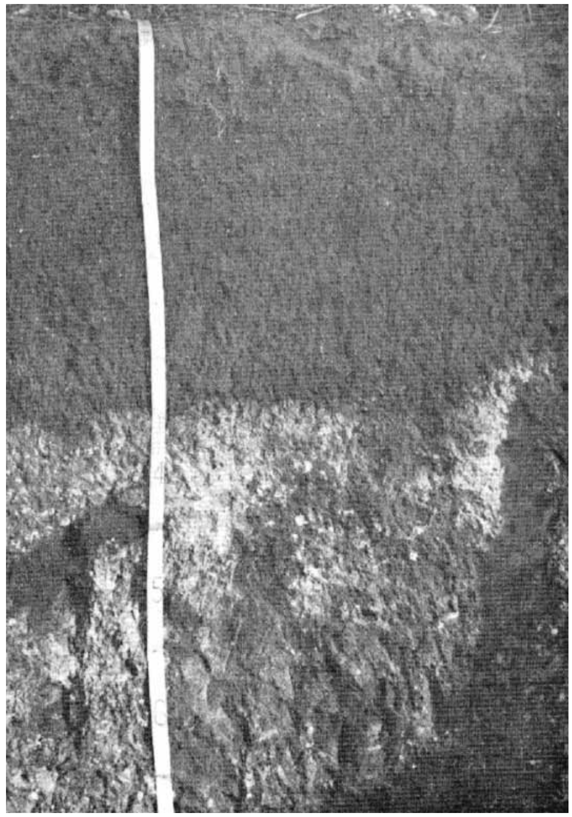


Figure 12.—Profile of a Pullman clay loam.

B24t—30 to 39 inches, yellowish-red (5YR 5/5) clay, yellowish red (5YR 4/5) moist; moderate, medium, subangular blocky structure; very hard, friable, slightly sticky, plastic; few fine roots; many very fine and few fine to medium pores, mostly common root channels; few clay films; few, fine, soft masses of calcium carbonate; few fine concretions of calcium carbonate; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B25t—39 to 46 inches, yellowish-red (5YR 5/5) clay, yellowish red (5YR 4/5) moist; moderate, medium, subangular blocky structure; very hard, friable, slightly sticky, plastic; few fine roots; many very fine and few fine to medium pores, mostly common to many root channels; few clay films; common threads and few films of calcium carbonate; few, fine, soft masses of calcium carbonate; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B26tca—46 to 72 inches, pink (5YR 8/3) silty clay loam, pink (5YR 7/4) moist; massive and porous to weak, medium, subangular blocky structure; hard, friable, slightly sticky, plastic; many very fine and fine pores mostly common root channels; about 60 percent, by volume, soft pink calcium carbonates; calcareous; moderately alkaline; clear, smooth boundary.

B27t—72 to 84 inches, reddish-yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) moist; weak, medium, subangular blocky structure and massive; hard, friable, slightly sticky, plastic; many very fine and fine pores, mostly common root channels; few clay films; about 25 percent, by volume, soft calcium carbonate masses about 15 percent of which is pink; calcareous; moderately alkaline.

The A horizon ranges from 6 to 10 inches in thickness. It ranges from dark grayish brown to dark brown or brown in color and from clay loam to silty clay loam in texture. Texture in profiles in range land ranges from silt loam in the upper 1 to 2 inches to clay loam or silty clay loam in the lower part. The B21t horizon is 3 to 8 inches thick and has weak, blocky to moderate, medium, blocky structure. The B22t horizon is dark brown or dark grayish brown in color and has moderate, medium and fine, blocky structure to strong, medium, blocky structure. The B24t and B25t horizons are similar, except that the B25t horizon has slightly more carbonates, and just above the B26tca horizon, the B25t horizon has several inches of soil of much lower bulk density. These horizons are reddish brown, yellowish red, brown, strong brown, or light brown in color and contain slightly less clay than the overlying horizons. They range from clay to clay loam in texture. The B26tca horizon ranges from pink to reddish yellow in color. It has carbonates as fine concretions and soft to hard chalky masses ranging from 15 to 60 percent, by volume. The B27t horizon is mostly reddish yellow or yellowish red in color.

Pullman clay loam, 0 to 1 percent slopes (PUA).—This soil is a nearly continuous area on a featureless plain. This plain is dotted with playas and depressional areas and interrupted by entrenched draws. The slopes are generally very slightly convex and average about 0.3 percent. They generally face in a southeasterly direction. This soil has the profile described as representative for the series.

Included with this soil in mapping are areas of Estacado soils, 1 to 5 acres in size. Also included, in large areas of this Pullman soil, are areas of Pullman clay loam, 1 to 3 percent slopes. These inclusions are 3 acres or less in size. There are also areas of Randall clay, less than 4 acres in size, and areas of Olton soils in broad transitional areas between Olton and Pullman soils. These inclusions make up less than 5 percent of the area.

This soil is well suited to large-scale farming, and nearly all of it is in crops. The principal crops are sorghums and small grain. Other important crops are vegetables, sugar beets, alfalfa, and cotton. A few areas are in native range. The hazards of soil blowing and water erosion are slight.

Terraces and contour farming are needed on long slopes to control water erosion, Crop rotation and use of crop residue on the surface help to control soil blowing and maintain soil condition. If this soil is irrigated, management needs include application of fertilizer, management of irrigation water in a properly designed irrigation system, and use of a recovery system for runoff irrigation water or grassed waterways and diversion terraces to safely carry off excess water in places.

The dominant climax grasses on this soil are blue grama and buffalograss. Buffalograss becomes more abundant if a site is overgrazed. The main invaders are three-awn and broom snakeweed, but these plants invade slowly. The total annual production of air-dry herbage on range in excellent condition is 1,000 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-3, dryland, and IIs-1, irrigated; Deep Hardland range site)

Pullman clay loam, 1 to 3 percent slopes (PuB).—This soil has smooth, slightly convex slopes and borders playa basins or draws. Areas generally occur as broad bands, 30 to 300 acres in size that surround the larger basins. The slope is mainly between 1 and 2 percent.

This soil has a surface layer of dark-brown clay loam 7 inches thick. The next layer is dark-brown and brown clay about 23 inches thick. The next 16 inches is yellowish-red clay. Below this is about 26 inches of pink silty clay loam. It is underlain by reddish-yellow silty clay loam.

Included with this soil in mapping are areas of Estacado and Olton soils less than 5 acres in size. Also included, in areas where water concentrates or in areas on lower slopes, are eroded areas 3 to 4 acres in size.

This soil is well suited to cultivation, and most areas are cultivated. The principal crops are small grain and sorghums. Other important crops are vegetables, sugar beets, alfalfa, and cotton. A few areas are in native range. The hazard of water erosion is moderate. The hazard of soil blowing is slight.

If this soil is dryfarmed, management needs include terracing and contour tillage to help control water erosion and managing crop residue on the surface to control soil blowing and maintain or improve soil condition.

If this soil is irrigated, management should include use of bench leveling or graded borders and planned irrigation water management system to control water and help prevent erosion, grassed waterways and diversion terraces to safely carry off excess water in places, and, commonly, a recovery system for runoff irrigation water. Application of fertilizer and return of large amounts of crop residue to the soil are also needed.

The dominant climax grasses on this soil are blue grama and buffalograss. Buffalograss becomes more abundant if a site is overgrazed. The main invaders are three-awn and broom snakeweed, but these plants invade slowly. The total annual production of air-dry herbage on range in excellent condition is 1,000 to 2,200 pounds per acre, depending on variations in rainfall. (Capability unit IIIe-1, dryland, and IIIe-1, irrigated; Deep Hardland range site)

Randall Series

The Randall series consists of deep, nearly level, neutral, clayey soils. These soils are on floors of playa basins and are inundated for several weeks or more each year. They formed in reworked sediments of the eolian mantle. These soils, under natural conditions, have a characteristic microrelief of microknolls and microbasins (gilgai). This microrelief is caused by swelling and shrinking of the soils.

In a representative profile (fig. 13), the upper 37 inches is dark-gray clay. Below this, to a depth of about 20 inches, is grayish-brown clay.

The Randall soils are somewhat poorly drained and very slowly permeable. The available water capacity is high.

Representative profile of Randall clay, 14 miles south and 6 miles east of Dimmitt, in a playa (2,500 feet south and 100 feet west of the northeast corner of section 20, block S-3):

A1—0 to 12 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, fine, blocky structure; very hard, very firm, very sticky, plastic; the surface of this horizon is moderate, medium and fine, subangular blocky and granular and contains much decomposing organic matter; neutral; diffuse, smooth boundary.

AC1—12 to 37 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, medium and fine, blocky structure; extremely hard, very firm, very sticky, plastic; peds have shiny pressure faces moist and are dull dry; wedge-shaped parallelepipeds; distinct intersecting slickensides; mildly alkaline; diffuse, smooth boundary.

AC2—37 to 84 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse, blocky structure; extremely hard, firm, very sticky, plastic; few threads of decaying roots and organic stains; few, fine, black, iron-manganese oxide concretions; pressure slides and slickensides; calcareous; moderately alkaline; diffuse, smooth boundary.

Figure 13.—Profile of Randall clay.

C—84 to 120 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; weak, coarse, blocky and subangular blocky structure; very hard, friable, sticky, plastic; noncalcareous in matrix, calcareous around very few threads of calcium carbonate; moderately alkaline.

The A horizon varies in thickness with the microrelief. It ranges from 6 inches in the center of knolls to more than 25 inches in the depressions. This horizon is typically dark gray in color, but it ranges to gray and, in a few areas, to very dark gray. The AC horizon extends to a depth of 40 to 90 inches. This horizon ranges from gray to dark gray to grayish brown in color. Reaction ranges from neutral to moderately alkaline. The AC horizon and the upper part of the C horizon have vertical wedges of soil material that is moderate to weak, granular and subangular blocky; this material has fallen down the deep cracks from the surface. In a few playas, the C horizon is fine sand.

Randall clay (Ra).—This deep soil is in concave, oval, flat-bottomed playas. Most areas range from 20 to 50 acres in size, but some areas are smaller. The slope is nearly level and ranges to 0.2 percent along the edge of the playas. During wet seasons, this soil is covered by a few inches to several feet of water that stands on the soil for several months in places (fig. 14).

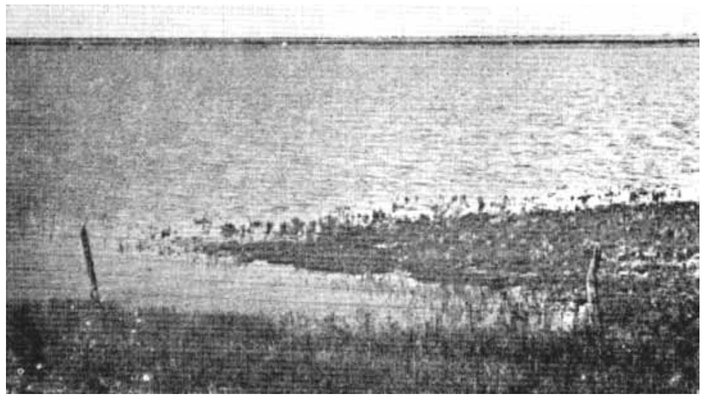


Figure 14.—Randall clay covered by water, an excellent alighting place for waterfowl.

This soil is not generally cultivated unless it is drained. Germination, irrigation, and cultivation are concerns of management on this clayey soil if it is in crops. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The vegetation consists chiefly of sedge and smartweed. Some western wheatgrass and buffalograss are present. In areas that receive only rainfall, grazing is good. The extensive flooding of playas by irrigation waste water that stands in the playas most of the summer has resulted in cattails covering or partly covering playa bottoms in recent years. Cattle do not graze these flooded playas, but they are suited to wildlife and waterfowl. During very wet seasons, all vegetation, or all vegetation except sedge and smartweed, are drowned. (Capability unit VIw-1, dryland; included in range site of surrounding soils)

Spur Series

The Spur series consists of deep, nearly level, calcareous, loamy soils that are frequently flooded. These soils formed in reworked material of the eolian mantle. They are along the channels of the larger draws. They are not flooded for long periods, because the channel and slope allow removal of runoff water. In Castro County, Spur soils are mapped only in an undifferentiated unit with Bippus soils.

In a representative profile, the surface layer is calcareous, dark grayish-brown clay loam about 19 inches thick. There is 2 inches of recently deposited, brown clay loam on the surface, and brown layers are within this layer. The layer beneath the surface layer is calcareous, brown clay loam about 29 inches thick. The underlying material, to a depth of about 80 inches, is brown sandy clay loam.

Spur soils are well drained and moderately permeable. Runoff is slow and the available water capacity is high.

Representative profile of a Spur clay loam, in an area of Bippus and Spur soils, frequently flooded, 11 miles south and 7 miles west of Dimmitt in rangeland (250 feet south and 1,000 feet west of the northeast corner of section 7, block T4, F.A. Thompson survey):

A11—0 to 2 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; very weak, platy structure; slightly hard, very friable, slightly sticky, plastic; crowns of grass are deeper than normal; few very thin strata of fine sandy loam; some undecomposed grass leaves ¼ inch deep on the surface; few very fine concretions of calcium carbonate; calcareous; moderately alkaline abrupt, smooth boundary.

A12—2 to 11 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, very coarse, prismatic structure parting to moderate, medium, subangular blocky and granular structure; slightly hard, very friable, slightly sticky, plastic; abundant roots; many fine and medium pores; many worm casts (40 percent, by volume); few very fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

A13—11 to 13 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate to weak, subangular blocky and granular structure; slightly hard, very friable, slightly sticky, plastic; many roots; many fine and medium pores; about 1/3 of this horizon appears to be worm casts from horizon above or below; many fine and medium pores; few threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

A14—13 to 19 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, very coarse, prismatic structure parting to moderate, medium, subangular blocky and granular structure; slightly hard, very friable, slightly sticky, plastic; many roots; many fine and medium pores; many worm casts, about 40 percent, by volume; few calcium carbonate threads; calcareous; moderately alkaline; gradual, smooth boundary.

B—19 to 48 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) moist; weak, very coarse, prismatic structure parting to weak, subangular blocky and granular structure; slightly hard, very friable, slightly sticky, plastic; many roots; many fine and medium pores; common to few worm casts in the lower part; few threads and films of calcium carbonate; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

C—48 to 80 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/3) moist; weak, very coarse, prismatic structure parting to weak, subangular blocky and granular structure; slightly hard, very friable, slightly sticky, plastic; few roots; many fine and medium pores, mostly old root channels; many fine concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from clay loam to sandy clay loam or fine sandy loam in texture and from dark grayish brown and brown to dark brown in color. This horizon ranges from 11 to 20 inches in thickness. The B horizon ranges from clay loam to sandy clay loam in texture. The C horizon generally contains less clay than the A and B horizons, and it ranges from clay loam to sandy clay loam and fine sandy loam in texture. This horizon ranges from brown to light brown or pale brown in color.

Use and Management of the Soils

This section explains the system of capability grouping used by the Soil Conservation Service to classify soils according to suitability for crops and defines the capability units established in Castro County; it shows the yields to be expected from those soils suitable for crops, irrigated and nonirrigated; it discusses the classification of soils into range sites and defines the range sites established in Castro County; it shows the relative suitability of the soils for management as wildlife habitat; and it presents a summary of soil characteristics that affect engineering practices and interpretations of these characteristics in terms of specific uses.

Management of an individual soil when used for farming or ranching is discussed under the name of the soil in the section “Descriptions of the Soils.” The capability classification and range site classification of each soil are given at the end of the soil description.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range or engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (None in Castro County.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes. (None in Castro County.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the two sets of capability units in Castro County are defined. All soils in the county have been placed in units for dryland farming. Those soils suitable for irrigation have been placed in units for irrigated farming. Suggestions for use and management are given under the names of the individual soils in the section "Descriptions of the Soils."

CAPABILITY UNITS FOR DRYLAND SOILS

Unit IIe-1.—Deep, nearly level, moderately permeable, loamy soils.
Unit IIIe-1.—Deep, gently sloping, very slowly permeable, loamy soils.
Unit IIIe-2.—Deep, gently sloping, moderately slowly permeable to moderately permeable, loamy soils.
Unit IIIe-3.—Deep, nearly level, very slowly permeable, loamy soils.
Unit IIIe-4.—Deep, nearly level, moderately slowly permeable to moderately permeable, loamy soils.
Unit IVe-1.—Deep, gently sloping, moderately slowly permeable to moderately permeable, loamy soils.
Unit IVe-2.—Deep, nearly level to gently sloping, moderately permeable, limy, loamy soils.
Unit IVe-3.—Deep, gently sloping, moderately permeable, loamy soils.
Unit IVe-4.—Deep, gently sloping, moderately permeable, loamy soils.
Unit IVs-1.—Deep, nearly level, very slowly permeable, clayey soils.
Unit Vw-1.—Deep, frequently flooded, moderately permeable, loamy soils.
Unit VIe-1.—Deep, sloping, moderately permeable, loamy soils.
Unit VIe-2.—Deep, gently sloping to sloping, moderately permeable, limy, loamy soils.
Unit VIw-1.—Deep, nearly level, somewhat poorly drained, very slowly permeable, clayey soils.
Unit VIIs-1.—Very shallow over slightly platy caliche, gently sloping to sloping, moderately permeable, loamy soils.

CAPABILITY UNITS FOR IRRIGATED SOILS

Unit IIe-1.—Deep, nearly level, moderately slowly permeable to moderately permeable, loamy soils.
Unit IIs-1.—Deep, nearly level, very slowly permeable, loamy soils.
Unit IIIe-1.—Deep, gently sloping, very slowly permeable, loamy soils.
Unit IIIe-2.—Deep, gently sloping, moderately slowly permeable to moderately permeable, loamy soils.
Unit IIIe-3.—Deep, gently sloping, moderately slowly permeable to moderately permeable, loamy soils.
Unit IIIe-4.—Deep, nearly level to gently sloping, moderately permeable, loamy soils.
Unit IIIe-5.—Deep, gently sloping, moderately permeable, limy, loamy soils.
Unit IVe-1.—Deep, gently sloping, moderately permeable, loamy soils.
Unit IVe-2.—Deep, gently sloping, moderately permeable, loamy soils.
Unit IVs-1.—Deep, nearly level, very slowly permeable, clayey soils.

Predicted Yields

Predicted average yields per acre of principal crops on soils of Castro County that are commonly cropped are shown in table 2. The predicted yields of wheat, grain sorghum, and cotton are given for both dryland and irrigated soils under a high level of management. The predicted yields of alfalfa are given for irrigated soils. These are average yields to be expected over a period of years. During periods of drought, dryland soils produce little or nothing. Although small acreages of crops other than those listed are grown in Castro County, the yields for these crops are not listed, because sufficient data on yields are not available on most of the mapping units.

The figures given in the table are based on information obtained from research; on interviews with farmers; and on observations of others who know the soils and crops of the county.

The high level of management is one in which farmers use all of the better practices for managing soils, plants, and water.

A high level of management for irrigated soils is a farming system that conserves precipitation and includes soil-conditioning crops in the cropping system. This management includes an irrigation system that is designed to meet the needs of the growing crops and the need to use irrigation water efficiently. Crop residue is left on or near the surface during critical periods of soil blowing and water erosion. Under a high level of management, the soil is not tilled when wet. Soil tillage is timely and is held to a minimum. Fertilizer is used in amounts determined by soil analyses and crop needs.

Under a high level of management on soils used for pasture or hay, adapted perennial grasses or legumes are used to meet forage requirements of livestock. Grazing and cutting heights of forage plants are controlled to utilize soil depth and to maintain vigor for production and cover for erosion control. Fertilizer is applied to meet soil, plant, and livestock needs. Management facilities include pens and water facilities, and fences are properly located to permit superior application of locally approved plant and livestock management techniques.

Under a high level of management for dryland soils, precipitation is conserved and minimum but timely stubble-mulch tillage is used to prevent breakdown of soil structure, to control weeds, and to prepare the seedbed. Crop residue is conserved and used to help prevent soil loss. Crops are rotated. Close-growing and soil-protecting crops are alternated with clean-tilled and erosion-permitting crops. Diversion terraces, terraces, and contour farming are used if needed.

Range Management

By JOHN A WRIGHT, Range Conservationist, Soil Conservation Service.

Native rangeland covers 90,000 acres in Castro County. There are 20 ranching units in the county. The average size is 1,200 acres, but these units range from 300 to 2,000 acres in size. Approximately 60 percent of these units also include varying amounts of cropland. The main crops are grain sorghum, wheat, and vegetables.

Livestock operations include cow-calf and stocker cattle enterprises. Some involve a combination of the two. Stocker cattle are grazed primarily on wheat in winter. Growth of feedlot operations has created an increased interest in stocker cattle. Some livestock men keep calves from their herds, run them as stockers if forage is available, and then place them in nearby feedlots.

Range sites and condition classes

Soils are grouped into range sites on the basis of similarity in the characteristics that affect their capacity for producing native forage plants. Each site has a distinctive potential, or climax, plant community, the composition of which depends on a combination of environmental factors, including soil, topography, and climate. The potential, or climax, plant community reproduces itself so long as the environment remains undisturbed.

Six range sites are recognized in Castro County. The plant community on each of these sites differs from that on the other five in such a way and to such a degree as to necessitate different types of management. The range sites in the county are identified as follows:

Deep Hardland range site.—Deep, calcareous and noncalcareous, nearly level to gently sloping, clayey loam and loam soils on tablelands; these soils produce short grasses.

Hardland Slopes range site.—Deep, calcareous, nearly level to sloping, fine sandy loam to clayey loam soils; these soils produce short grasses and traces of mid grasses (fig. 15).

High Lime range site.—Deep, calcareous, gently sloping to sloping loamy soils on dunes; these soils produce short grasses.

Loamy Bottomland range site.—Deep, calcareous, nearly level to gently sloping, loamy soils along intermittent streams that flood frequently; these soils produce tall grasses.

Mixedland Slopes range site.—Deep, calcareous, gently sloping to sloping, fine sandy loam soils; these soils produce tall and mid grasses.

Very Shallow range site.—Gently sloping to sloping, loam soils that are very shallow over slightly platy caliche; these soils produce thin stands of short grasses.

The range site classification of each soil in the county is shown at the end of the descriptions of the mapping units in the section "Descriptions of the Soils". Information about the composition of the climax vegetation and the productivity of each soil is given in the soil descriptions.

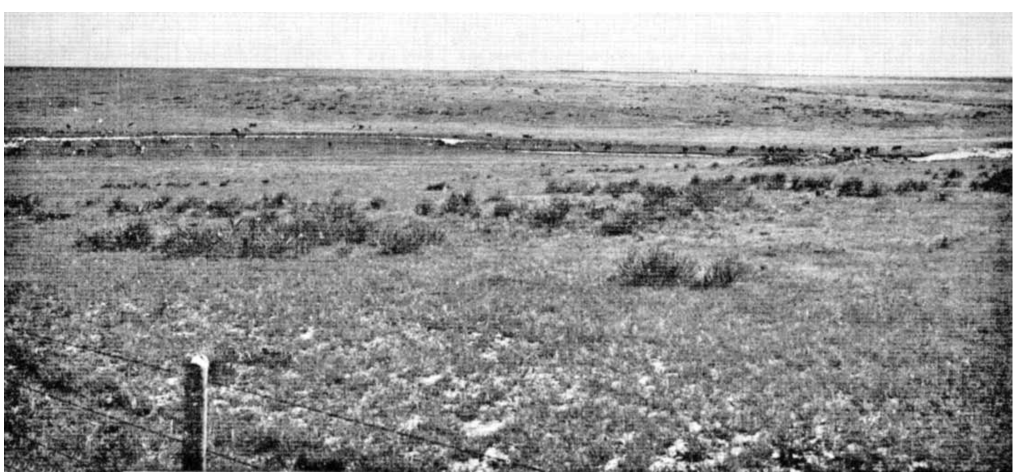


Figure 15.—Hardland Slopes range site in foreground. The soils are Mansker-Estacado loans, 3 to 5 percent slopes.

Range condition is rated by comparing the composition of the existing plant community with that of the potential plant community. Four range condition classes are recognized: excellent, good, fair, and poor. A range is in *excellent* condition if 76 to 100 percent of the existing vegetation is of the same composition as that of the potential stand. It is in *good* condition if the percentage is between 51 and 75, in *fair* condition if the percentage is between 26 and 50, and in *poor* condition if the percentage is less than 26.

The plants on any given range site are grouped according to their response to grazing and as decreasers, increasers, and invaders. *Decreasers* are plants in the potential plant community that tend to die out if heavily grazed. *Increasers* are plants in the potential community that become more abundant as the decreasers decline, and then start to die out if heavy grazing continues. *Invaders* are plants that are not a part of the original stand, but they generally take over if both the increasers and decreasers disappear.

Wildlife

Large numbers of jackrabbits, scaled (blue) quail, bob-white quail, dove, cottontail rabbits, badgers, ground squirrels, mice, rats, various songbirds, and predators, such as hawks, foxes, and coyotes, inhabit Castro County. Also present are raccoons, skunks, opossums, and prairie dogs. Stubble fields furnish cover for a large number of pheasants that were introduced into the county. Grainfields attract migrating ducks and geese, many of which alight on playa lakes, intermittent streams, and impoundments. Rattlesnakes are the only poisonous snakes in the county. Production of fish is limited to a few playas into which extra water is pumped and to farm and ranch ponds and similar artificial impoundments.

All of Castro County is a nearly level to sloping, treeless prairie. It is dissected by a few intermittent streams and some sloping basins around playas. Only a few native legumes, such as wild alfalfa, and a few varieties of wild herbaceous upland plants are present. Because no native trees and only widely scattered short shrubs are present, brushland wildlife habitat is very limited. About 90,000 acres of the county remains in native grass; the rest is cultivated. Most of the once-abundant wildlife was killed off after livestock was brought in, and the area was over-grazed, fenced, or cultivated. Although deer, pronghorn, and bison once roamed the prairie, none remain today. Prairie dogs were once plentiful but are now almost extinct. Prairie chickens originally were abundant.

Interpretations for wildlife habitat

Soil interpretations for wildlife habitat serve a variety of purposes. They are an aid in selecting the more suitable sites for various kinds of management. They serve as indicators of the level of management needed to achieve satisfactory results and as a means of showing why it is generally not feasible to manage a particular area for a given kind of wildlife. They also help in broad-scale planning of wildlife management areas, parks, and nature areas, or for acquiring wildlife areas.

Successful management of a tract as wildlife habitat requires that food, cover, and water be available in a suitable combination. Management consists mainly of planting suitable vegetation or of manipulating existing vegetation to bring about natural establishment, increase, or improvement of desired plants, or of a combination of such measures.

Soil properties that affect the growth of wildlife habitat are (1) thickness of soil useful to crops, (2) texture of surface layer, (3) available water capacity to a depth of 40 inches, (4) wetness, (5) surface stoniness or rockiness, (6) hazard of flooding, and (7) slope.

The soil areas shown on the soil survey map are rated without regard to their position in relation to adjoining delineated areas. The size, shape, or location of the outlined area does not affect the rating. Certain factors that influence habitats, such

In table 3 the soils of Castro County are rated according to their relative suitability for six elements of wildlife habitat and three kinds of wildlife. These ratings are based upon limitations imposed by the characteristics or behavior of the soils. Four levels of suitability are recognized. Numerical ratings of 1 to 4 indicate degrees of suitability for a given habitat element.

The meanings of the numerical ratings are as follows:

A rating of 1 (well suited) means that a habitat generally is easily created, improved, or maintained; that the soil has few or no limitations that affect management; and that satisfactory results can be expected.

A rating of 2 (suited) indicates that a habitat can be created, improved, or maintained in most places; that the soil has moderate limitations that affect management; and that a moderate intensity of management and fairly frequent attention is required for satisfactory results.

A rating of 3 (poorly suited) indicates that a habitat can be created, improved, or maintained in most places; that the soil has severe limitations; that habitat management is difficult and expensive and requires intensive effort; and that results are not always satisfactory. For short-term use, soils that have a rating of 3 can provide easy establishment and temporary returns.

A rating of 4 (unsuited) indicates that the limitation is so extreme that it is impractical, if not impossible, to manage the designated habitat element and that unsatisfactory results are probable.

The six elements of wildlife habitat rated in table 3 are defined in the following paragraphs.

Grain and seed crops.—In the group of plants are grains and seed-producing annuals planted to produce food for wildlife. Examples are corn, sorghum, millet, soybeans, wheat, oats, and sunflowers.

Grasses and legumes.—In this group are domestic perennial grasses and legumes that are established by planting and that furnish food and cover for wildlife. Examples are blue grama, buffalograss, side-oats grama, western wheatgrass, vine-mesquite, sweetclover, and switchgrass.

Wild herbaceous upland plants.—In this group are perennial grasses, forbs, and weeds that provide food and cover for wildlife. Examples are ground cherry, wild rye-grass, and bluestem.

Hardwood trees and shrubs.—In this group are nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, or foliage (browse) used extensively as food by wildlife. These plants commonly become established through natural processes but are planted in places. Examples are sand sagebrush, mesquite, whitebrush, skunkbrush, catclaw, honeysuckle, Russian-olive, and multiflora rose.

Wetland food and cover plants.—In this group are annual and perennial wild herbaceous plants that grow in moist to wet sites and that produce food or cover that is extensively and dominantly used by wetland forms of wildlife. Examples are smartweed, barnyard grass, sedges, and cattails. Submerged and floating aquatics are not included.

Shallow water developments.—These are low dikes and water-control structures established to create habitat principally for waterfowl. They are so designed that they can be drained, planted, and flooded, or they are permanent impoundments in which submerged aquatics can be grown.

The three general kinds of wildlife rated in table 3 are defined in the following paragraphs.

Open-land wildlife.—This group is made up of birds and mammals that normally frequent cropland, pasture, range, and areas overgrown with grasses or weeds. Examples are quail, pheasant, cottontail rabbits, jackrabbits, and meadow larks.

Brushland wildlife.—This group is made up of birds and mammals that normally frequent wooded areas of hardwood trees and shrubs. In Castro County, these can be established if extra water is used. Examples are deer, turkeys, squirrels, and raccoons.

Wetland wildlife.—This group is made up of birds and mammals that normally frequent ponds, streams, ditches, and playas. Examples are ducks, geese, coots, gulls, kill-deer, curlew, plover, and lesser sandhill cranes.

Engineering Uses of the Soils

By DAN C. HUCKABEE, Area Engineer, Soil Conservation Service

This section provides information of special interest to engineers, contractors, farmers, and others who deal with soils as structural material or as foundation material upon which structures are built. It is concerned with those properties of soils that affect construction and maintenance of roads, airports, pipelines, building foundations, water storage facilities, erosion control structures, and sewage disposal systems. Among the soil properties important in engineering are permeability, compressibility, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan irrigation systems, farm ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 4, 5, and 6, which show estimates of several of the soil properties significant in engineering and interpretations for various engineering uses.

This information, along with the soil map and other parts of this survey, can be used to make interpretations in addition to those given in the tables, and it also can be used to make other useful maps.

This information does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables. Even in these situations, however, the soil map is useful in planning a more detailed investigation and for indicating the kinds of problems that can be expected. Also, inspection of sites, especially of small ones, is needed because many delineated areas of a given soil contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

No specific values should be inferred from the verbal estimates of traffic-supporting capacity.

Some of the terms used in this soil survey have different meanings in soil science than they have in engineering. The Glossary defines many of the terms commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (7), used by engineers of the Soil Conservation Service, the Department of Defense, and others, and the AASHO system (1), adopted by the American Association of State Highway Officials. An estimate of the classification of each soil in Castro County according to each of these systems is given in table 4.

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6.

Estimated engineering properties

In table 4 are estimates of several of the soil properties that are significant in engineering. The estimates are based on field classification and descriptions of the soils, on experience in working with the soils, and on physical and chemical test data for comparable soils in adjacent areas. No laboratory tests have been made to determine the engineering properties of the soils in Castro County.

Table 4 does not show depth to bedrock or depth to the water table, because in all the soils in the county bedrock and the water table are many feet below the surface.

Brief explanations of the columns in table 4 follow.

Soils are placed in four major hydrologic soil groups on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protection of vegetation. Group A consists of soils that have high infiltration rates, even when thoroughly wetted. These consist chiefly of deep, well-drained to excessively drained sands or gravels. These soils have a high rate of water transmission. They have a low runoff potential. There are no Group A soils in Castro County. Group B consists of soils that have moderate infiltration rates when thoroughly wetted. These consist chiefly of moderately deep to deep, moderately well drained to well drained soils that have a moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission. Group C consists of soils that have slow infiltration rates when thoroughly wetted. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine to fine texture. These soils have a slow rate of water transmission. Group D consists of soils that have very slow infiltration rates when thoroughly wetted. These consist chiefly of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and shallow soils underlain by nearly impervious material. These soils have a very slow rate of water

Soil texture is described in table 4 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. “Loam,” for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. “Sand,” “silt,” “clay,” and some of the other terms used in USDA textural classification are defined in the Glossary at the back of this survey.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 4 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH values and the terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Interpretations of engineering properties

Tables 5 and 6 contain selected interpretations useful to engineers and others who plan to use soil material in construction of highways, farm and ranch facilities, buildings, sewage disposal systems, and recreational facilities. The degrees of limitations are listed, along with the major soil features affecting the use of the soils. The ratings, degrees of limitation, and other interpretations in these tables are based on estimated engineering properties (see table 4); on available test data from nearby counties; and on field experience. While, strictly, the information applies only to the depths indicated in table 4, it is reasonably reliable to depths of about 6 feet for most soils, and to greater depths for some.

Table 5 gives interpretations of engineering properties for farm and ranch uses.

Farm pond reservoir areas.—The soil features that affect these areas are those that influence loss of water by seepage.

Farm pond embankments.—The soil features of both subsoil and substratum are those important to the use of the soils for constructing embankments. These embankments serve as dams.

Irrigation.—The soil features that affect irrigation include slope, permeability, thickness of the soil, and potential flood hazards that wash out irrigation systems in places. A few irrigation wells in Castro County are drilled into the Santa Rosa Formation. Generally, the water from the Santa Rosa Formation is saline enough to be detrimental for irrigation uses.

Terraces and diversions.—The soil features that affect these structures include erosion, thickness of the soil for construction, and slope. These structures are not commonly used on some soils.

Grassed waterways.—These are natural or shaped water-courses, covered with close-growing grass. They are used to carry off excess water from the terrace system. Soil features affecting waterways include slope, available water capacity, and soil structure as they affect grass growth, thickness of the soil, and erosiveness.

Table 6 gives interpretations pertaining to highways, buildings, and recreational uses.

Topsoil.—The soil material used to cover or resurface an area, where vegetation is to be established and maintained is topsoil. Properties considered are those that affect the productivity and workability of the soil material. These include texture, thickness of suitable material, organic matter, and presence of coarse fragments.

Road subgrade.—Material used to build embankments is called subgrade. The ratings indicate performance of soil material moved from borrow areas for those purposes. No specific values should be inferred from the verbal estimates of traffic-supporting capacity.

Highway location.—Features affecting this use are those of the undisturbed soil that affect construction and maintenance of highways. The soil features, favorable as well as unfavorable, are the principal ones that affect geographic location of highways. No specific values should be inferred from the verbal estimates of traffic-supporting capacity.

Foundations for low buildings.—Features chiefly affecting this use are those of the undisturbed soil that influence its capacity to support low buildings that have normal foundation loads. Specific values of bearing strength are not assigned.

Septic tank filter fields.—This use is affected mainly by seepage loss, location of water table, and susceptibility to flooding. The degree of limitation and principal reasons for assigning a moderate or severe limitation are given.

Sewage lagoons.—This use is influenced chiefly by soil features such as seepage loss, location of water table, and slope. The degree of limitation and principal reasons for assigning a moderate or severe limitation are given.

Camp areas.—Campgrounds for overnight or week-long camping need to be on soils that do not require hard surfacing for parking and that have no hard layers to interfere with setting tent pegs. Load bearing strength of the natural soil, as influenced by soil texture and soil moisture, is a particularly important criterion in this rating. Flooding, dustiness or muddiness, slope, and stoniness are other criteria used in rating the soils for camp areas. Grass-covered, tree-shaded grounds are most desirable for campsites.

Picnic areas.—These areas are defined as tree-shaded, park-type areas, complete with tables and cooking grills and readily accessible by automobile. It is assumed that vehicular traffic is confined to access roads. Flooding, slope, texture of the surface, and amount of coarse fragments on the surface are considered in making the evaluation.

Playgrounds.—These are natural soil areas to be used intensively as playing grounds for sports, such as baseball, football, volleyball, soccer, and other similar organized games. Subject to intensive foot traffic, these areas need to be nearly level, have good drainage, and have a firm surface free of rock outcrops and stones.

Paths and trails.—These are defined as footpaths, hiking trails, or bridle paths along which the seeker of recreation has the opportunity to enjoy the beauties of nature. In making the rating, it is assumed that only enough natural vegetation is removed to provide a pathway, and that there are few if any excavations or fills along the pathway. Because a grass cover cannot be maintained in the pathway, muddiness and dustiness are particularly important soil features considered in the rating. Other important soil features include stones or gravel on the surface, slope, flooding, and design and maintenance of these trafficways to minimize erosion.

Corrosivity.—Soils are rated at a depth of 4 feet. Properties that affect corrosion of uncoated steel pipe include drainage, texture, acidity, resistivity, and conductivity. Properties that affect corrosion of concrete include texture, reaction, and amount of sodium, magnesium sulphate, or sodium chloride present in the soil. Corrosivity of concrete is not a hazard in Castro County, and a column was not included in the table.

Winter grading.—Prolonged periods of cold weather are not severe enough to cause the soil to freeze below a depth of about 6 inches. This shallow frozen condition generally lasts for short periods. Winter grading is not limited in Castro County, and a column, therefore, was not included in the table.

Formation and Classification of the Soils

This section discusses the factors of soil formation as they exist in Castro County and shows the classification of the soils of the county according to the system currently used by the National Cooperative Soil Survey.

Factors of Soil Formation

The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and bring about the development of genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed, and in extreme instances, it determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on soils that few generalizations can be made regarding the effect of any one unless conditions are specified for the other four. Many of the processes of soil development are unknown. The following paragraphs briefly describe the parent material, climate, plant and animal life, and relief of Castro County and tell how time has affected the formation of the soils.

Parent material

Parent material has probably had more influence than any other factor on the kinds of soil that formed in this county (2,3). These soils formed in the geologic formation of the High Plains deposits.

High Plains deposits have two main parts. The lower part is the Ogallala Formation, and the upper part is a mantle of eolian material. The Ogallala Formation consists of calcareous outwash made up of sand, gravel, and caliche. It is exposed along some of the draws. The Potter soils formed in exposed material from that formation.

The upper part of the High Plains deposits, now roughly between 30 and 100 feet in thickness, consists of a mantle of loess that blankets most of the county. It is the formation in which most of the soils of the county formed. This mantle consists of alternating layers of clay loam, sandy clay loam, and loam interbedded with layers of soft, pinkish-white caliche.

The kind of soil that formed at any given place on the High Plains appears to have depended mainly on the kind of parent material at the surface at that particular place. The Pullman soils, for example, formed in material from the finer textured layers. The Mansker and Estacado soils are calcareous because they formed in limy material from the layers of loamy caliche. The Olton and Acuff soils formed in the layers of clay or sandy clay loam.

Several soils formed in reworked sediments from the mantle of loess. Among these are the Randall, Lipan, Drake, Bippus, and Berda soils. The Randall soils formed in playa basins in beds of clay settlings. The Drake soils formed in windblown sediments that have a high content of lime and that have blown out of the bottoms of playas during dry periods. The Berda soils formed in calcareous colluvium that has settled on slopes along draws below escarpments.

Probably the most obvious reworked material is that of the most recent geologic formations, which include the inextensive alluvial deposits along the streams. The Bippus and Spur soils formed in material deposited by streams.

Climate

The climate is uniform throughout the county, but its effects have been modified locally by relief and runoff. Because rainfall is low and there are long, dry periods, soil development is slow. The soils are seldom wet below the root zone, and, as a result, many have a horizon of calcium carbonate accumulation. Leaching has not removed free lime from the upper layers of the Mansker, Estacado, Posey, Berda, Drake, and Lipan soils.

In some soils, such as the Pullman, Lofton, Olton, and Acuff clay is moving from the surface layer into the lower layers. This is evidenced by the presence of clay films and by a more clayey texture in the lower layers than in the surface layer. The downward movement of clay is a process somewhat similar to the downward movement of carbonates by leaching, but it takes place at a much slower rate. Also, it apparently begins only after all the carbonates have been leached out.

Climate has affected the formation of some of the soils through the action of strong winds. The Drake soils that are on the eastern slopes of playas formed in strongly calcareous windblown sediments. These sediments were blown from the playa basins.

The wet climate of past geologic ages influenced the deposition of parent materials. Parent materials during these ages were also affected by wind. The wind has affected soil development from the time it deposited sands over pre-existing alluvial materials in the Illinoian stage of the Pleistocene epoch to its present shifting of coarse sands on the surface (2).

Plant and animal life

Plants, earthworms, micro-organisms, and other forms of life that live on and in the soil contribute to the development of the soil profile. The kinds of organisms are determined mainly by the climate and by the kinds of soil.

In Castro County, climate has limited the kind of vegetation mainly to grasses. The kinds of soil determined whether the grasses would be tall, as on the sandy soils, or short, as on the finer textured, loamy soils. The short grasses growing throughout most of the county contribute organic matter to the soils. When their leaves and stems decay, they add organic matter to the surface layer. When the fine roots die and decompose, they help to build up a supply of plant nutrients in the rest of the solum. As the roots decay, they provide food for bacteria, actinomycetes, and fungi. The network of pores and tubes left by decaying roots hastens the passage of air and water through the soils.

Earthworms are the most obvious form of animal life in most of the soils. The Estacado, Mansker, and Berda soils contain many worm casts, which are the round, granular excretions left by burrowing earthworms. In contrast, the Pullman soils contain few or no worm casts. Worm casts add greatly to the fertility of soils and to the movement of air, water, and plant roots through the profile.

Because of the part they play in releasing plant nutrients from the parent material, micro-organisms are important in the formation of soils. They take nitrogen from the air and store it in the soil. Also, they are active in helping to decompose plant residue.

In some soils rodents have, helped in the development of the profile. These animals mix the soil material in burrowing, and this mixing tends to offset the effects of the leaching of carbonates and the downward movement of clay. Nests made by rodents are common in the Pullman, Posey, Olton, Acuff, Mansker, and Estacado soils. The nests, or krotovinas, range from about 4 to 18 inches in diameter. They are filled with grayish brown, silty material that has high organic-matter content. Bison, pronghorn deer, rabbits, and other animals have also affected the formation of soils in various ways.

Man also has influenced soil formation by fencing the range and allowing it to lie overgrazed, changing the vegetation, and clearing and plowing the soils for crops. He has clean harvested the crops and has not controlled runoff and soil blowing. Because of these practices, organic matter has been depleted and silt and clay particles have been blown from the plow layer. Heavy machinery and untimely tillage have compacted the soil and have slowed the infiltration of water and air. Irrigation has drastically changed the natural moisture regime in some areas.

Relief

Relief influences the formation of soils, mostly through its effect on drainage and runoff. If other factors of soil formation are equal, the degree of profile development depends mainly on the average amount of moisture that enters and passes through the soil. Steep soils absorb less moisture than less sloping ones, and they are more susceptible to erosion. Therefore, they generally have a thinner, less well developed profile.

Some soils in the county, such as the Pullman, Olton, and Acuff, are nearly level or gently sloping. Most of the moisture from rainfall has penetrated those soils; therefore, relief has not been a limiting factor in the development of a soil profile.

In contrast, the Potter soils have been strongly influenced by relief. Because those soils are gently sloping to sloping, runoff is greater and geologic erosion is active. Rainfall penetrates to a limited depth, and the vegetation is sparse. As a result, the factors of vegetation, time, and climate can cause and sustain the formation of a soil that has a very shallow profile over the beds of caliche.

The Randall soils are also affected to some extent by relief. They are poorly drained and are covered by water for long periods. Consequently, some of the minerals in those soils, especially iron and manganese, have been changed, and the kinds and amounts of clay probably have been affected.

Time

Time is required for the formation of a soil. The amount of time required depends on the kind of parent material in which the soil formed and on the environment, that is, on the climate, plant and animal life, and relief. An old soil is considered to be stable within its environment. It changes little with the passage of time because the environmental factors have already exerted their influence on the parent material. A young soil, on the other hand, is one in which the climate, plant and animal life, and relief have only begun to alter the parent material. Thus, the age of a soil is determined by the degree to which the parent material has been changed toward the full development of a soil profile that has its own unique set of characteristics.

Soils of the Pullman, Acuff, and Olton series have been in place long enough to have developed a distinct profile. They are deep and have pronounced horizon development. Free lime has been leached into the lower horizons, and much of the clay has moved out of the surface layer and into the lower layers. The A and B horizons of these soils are distinct. The Drake soils, on the other hand, are young. They have been in place such a short time that horizons have only begun to form. A slight movement of lime into the lower layers has occurred, and the surface layer has been darkened somewhat by vegetation.

The Mansker soils are also young. Although considerable amounts of lime have moved out of the solum, these soils do not yet show the full effects of their environment. The horizons are weakly expressed.

Because of the clayey texture of the Randall soils, time probably has had little influence on the development of a profile in those soils. The factors of parent material and relief have been dominant, in the formation of the Randall soils. The profile of those soils will probably not change much in the future unless some change takes place in the environment.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research.

Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The current system of classification was adopted by the National Cooperative Soil Survey in 1965. The system has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. The placement of some soil series in the current system, particularly in families, may change as more precise information becomes available. Readers interested in the development of the system should refer to the latest literature available (4, 6). Table 7 shows the classification of the soil series in this county according to the family, subgroup, and order.

The criteria for classification in the current system are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together.

The categories in the classification system are defined as follows:

ORDER: Soils are grouped into orders according to properties that seem to have resulted from the same processes acting to about the same degree on the parent material. Ten soil orders are recognized in the current system: Alfisols, Aridisols, Entisols, Histosols, Inceptisols, Mollisols, Oxisols, Spodosols, Ultisols, and Vertisols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Six of the ten soil orders are represented in Castro County: Alfisols, Aridisols, Entisols, Inceptisols, Mollisols, and Vertisols.

Alfisols are soils containing a clay-enriched B horizon that has high base saturation. This order is represented by soils of the Posey series.

Aridisols are primarily soils of dry places. They have a light-colored surface soil and free carbonates throughout their profile. This order is represented by soils of the Potter series.

Entisols are recent soils in which there has been little, if any, horizon development. This order is represented in this county by soils of the Drake series.

Inceptisols occur mostly on young, but not recent, land surfaces. This order is represented by soils of the Berda series.

Mollisols are dark-colored soils that have a moderate to high content of organic matter and high base saturation. Some have a clay-enriched B horizon, and others have free carbonates throughout their profile. This order is represented by soils of the Acuff, Bippus, Estacada Lofton, Mansker, Olton, Pullman, and Spur series.

Vertisols are soils in which natural churning or inversion of soil material takes place, mainly through the swelling and shrinking of clays. This order is represented by soils of the Lipan and Randall series.

SUBORDER: Each order is divided into suborders, primarily on the basis of soil characteristics that indicate genetic similarity. The suborders have a narrower climatic range than the orders. The criteria for suborders reflect the presence or absence of waterlogging or soil differences resulting from climate or vegetation.

GREAT GROUP: Each suborder is divided into great groups on the basis of uniformity in kind and sequence of genetic horizons. The great group is not shown in table 7, because the name of the great group is the same as the last word in the name of the subgroup.

SUBGROUP: Each great group is divided into subgroups, one representing the central (typic) concept of the group, and others, called intergrades, that have properties of one great group but also one or more properties of another great group.

FAMILY: Families are established within subgroups primarily on the basis of properties important to plant growth. Some of these properties are texture, mineralogy, reaction, soil temperature, permeability, consistence, and thickness of horizons.

SERIES: The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important, characteristics and in arrangement, in the profile.

Climate

Castro County has a dry-steppe climate. Winters are mild. The average annual precipitation is 17.50 inches, and approximately 78 percent of this amount falls during the warm season, May through October. Rains occur most frequently as the result of thunderstorms, and monthly and annual amounts are extremely variable. Annual extremes since 1923 have ranged from 39.56 inches in 1941 to only 8.35 inches in 1956.

Castro County experiences a wide annual range in temperature. The average difference between summer and winter temperature extremes is 97° F. The prevailing winds are southwesterly from November through April and southerly from May through October. Wind speed averages about 13.6 miles per hour. The average annual relative humidity is estimated at 70 percent at 6:00 a.m., 40 percent at noon, and 39 percent at 6:00 p.m. Seasonal variations in relative humidity are small. Castro County receives approximately 74 percent of the total possible sunshine annually.

A summary of climatological data for Castro County is shown in table 8.

Winter is characterized by frequent surges of cold polar air, which brings strong northerly winds and rapid drops in temperature cold spells are of short duration, and they rarely last longer than 18 hours before sunshine and southwesterly winds bring rapid warming. Freezes occur almost every night, but days are generally sunny. The average daily maximum temperature is 53.3°. Winter is a dry season. Precipitation most often occurs in the form of light snow. The area receives approximately 70 percent of the total available sunshine in winter.

Spring is a season of frequent weather changes. Warm and cold spells follow each other in rapid succession through Match and April. These are the windiest months of the year. Infrequently, strong, persistent southwesterly to northwesterly winds produce dust storms in the area. Thunderstorms, which rarely occur in winter, increase in number through the spring season and reach a peak in May and June.

Summer is a pleasant season. Afternoon temperatures are sometimes hot, but most nights are pleasantly cool. The average minimum temperature is 60.6° in summer. Evaporative type air conditions operate efficiently this relatively dry climate. Forty-five percent of the average annual precipitation falls during the summer season of June through August, and 58 percent of the annual total falls in the 4- month period of May through August. June is usually the wettest month. A few thunderstorms late in spring and early in summer are accompanied by damaging wind and hail in places. Thunderstorm activity gradually decreases throughout July and August. Thunderstorms occur on an average of 45 days annually.

Fall is the most pleasant season. A greater variety of weather occurs during this season than in summer as cold fronts again push southward across the High Plains. Rainfall is less in September and October than in August, then it drops off more sharply in November. Mild, sunny days and crisp, cool nights characterize the fall season.

The freeze-free period in Castro County averages 193 days. The average dates of the last occurrence of 32° or below in spring and the first occurrence of 32° or below in fall are April 16 and October 26, respectively. Low temperature readings depend greatly on variations in topography, air drainage, and wind. Also, differences normally exist between urban and rural areas; therefore, some departures from the above dates are likely to be found within the county.

History and Settlement

The area that is now Castro County was originally the hunting grounds of the Comanches, Kiowas, Apaches, and other Indian tribes that hunted bison, deer, and antelope. Prairie dog towns spread for miles.

When the count was organized in 1871, all of it was open range. Ranchers began to come into the area in the 1880's. Homesteaders followed in about 1898, then the State land was opened to settlement.

From 1912 to 1925, much of the sod in Castro County was plowed up. The county became an area of extensive dryland farming and ranching. Then, the drought of the thirties struck the Great Plains. Disastrous lack of rainfall, and low market prices forced many farmers to leave the area.

The early forties brought a series of wet years, and irrigation from wells was begun about that time. Also, much had been learned during the drought period about how to farm the soils to control soil blowing. Irrigation, improved farming practices, and better outlets for farm products have been the main factors that have produced a stable farming area. At present, wheat and grain sorghum are the main crops, but sugar beets and irrigated vegetables are grown in large acreages. In 1970, about 84 percent of the acreage in the county was in dryland or irrigated crops.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8. 2 v., illus.

(2) FRYE, JOHN C. AND LEONARD, A. BYRON
1957. STUDIES OF CENOZOIC GEOLOGY ALONG EASTERN MARGIN OF TEXAS HIGH PLAINS, ARMSTRONG TO HOWARD COUNTIES. Univ. Tex. Bur. Econ. Geol. Report 32, 60 pp., illus.

(3) LOTSPEICH, F. B. AND COOVER, J. R.
1962. SOIL FORMING FACTORS ON THE LLANO ESTACADO: PARENT MATERIAL, TIME, AND TOPOGRAPHY. Tex. Jour. of Sci., v. XIV, No. 1, pp. 7-17, illus.

(4) SIMONSON, ROY W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Std. 137: 1027-1034.

(5) UNITED STATES DEPARTMENT OF AGRICULTURE
1951. SOIL SURVEY MANUAL. U.S. Dept. of Agr. Handbook 18, 503 pp., illus. [Supplement issued in May 1962]

(6)
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, THE APPROXIMATION. 265 pp., illus. [Supplements issued in March 1967 and September 1968]

(7) UNITED STATES DEPARTMENT OF DEFENSE
1968. UNIFIED SOIL CLASSIFICATION SYSTEM FOR ROADS, AIRFIELDS, EMBANKMENTS, AND FOUNDATIONS. MIL-STD-619B, 30 pp., illus.

Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Buried soil. A developed soil, once exposed but now overlain by more recently formed soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm Temperature areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Chlorosis. A yellowing between veins on upper foliage that results from chlorophyll deficiency. Many factors, including heredity, cause chlorosis.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains pellets or nodules of various sizes, shapes and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firma.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky. When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Diversion terrace, or diversion. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Fine-textured soils. *Moderately fine textured*: clay loam, sandy clay loam, silty clay loam; *fine textured*: sandy clay, silty clay, and clay. Roughly, soil that contains 35 percent or more of clay.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, and covered by grass for protection against erosion, used to conduct water away from cropland.

Gravel. As a soil separate, the rounded or angular fragments of rock that are as much as 3 inches in diameter. As a soil textural class, soil material that consists of 15 to 50 percent gravel by volume in engineering, gravel is a coarse-grained soil of which more than 50 percent is retained on a No. 4 screen.

Horizon. A layer of soil approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which lining organizers are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that; in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Loam. The textural class name for a soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Medium-textured soil. Soil of very fine sandy loam, loam, silt loam, or silt texture.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma, for example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Outwash material. A mantle of soil material. A few feet to 60 feet thick or more, washed from the High Plains and Rocky Mountains by streams of melt water and deposited on the Permian red beds during glacial times.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid*.

Phase, soil. A subdivision of a soil series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type for example, may be divided into phases because of differences in slopes, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

Playa. A flat-bottomed, undrained basin or lakebed that contains water for varying periods following rains. Some playas are dry for long periods and are farmed.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Pore, soil. Open channels in the soil material caused by roots and forms of animal life, such as earthworms and insects. Following are the terms used to define soil pores: Amount—few, less than 5 per square inch; common, 5 to 25 per square inch; many, more than 25 per square inch. The size measurements are: very fine, less than 0.25 to 1.0 millimeter in diameter; medium, 1.0 to 3.0 millimeters in diameter; and coarse, 3.0 millimeters and larger.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid or "sour" soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.1 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more dust 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows*: Very coarse sand (2.0 to 1.0 millimeter); coarse sand*, (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter) and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than (0.002 millimeter).

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregated and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and granular. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Stubble mulching. Maintaining a protective cover by leaving crop residue as a mulch on the surface of the soil until time to seed the next crop. This protects the soil from hot sun, packing rains, and erosion.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to the prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent soil.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further decided by specifying, “coarse” “fine,” or “very-fine.”

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Acuff loam, 0 to 1 percent slopes	7, 300	1. 3	Mansker-Berda loams, 5 to 8 percent slopes	4, 570	. 8
Acuff loam, 1 to 3 percent slopes	11, 350	2. 0	Mansker-Estacado loams, 3 to 5 percent slopes	8, 660	1. 5
Acuff loam, 3 to 5 percent slopes	1, 000	. 2	Olton clay loam, 0 to 1 percent slopes	132, 030	23. 4
Berda fine sandy loam, 3 to 5 percent slopes	710	. 1	Olton clay loam, 1 to 3 percent slopes	31, 230	5. 5
Berda fine sandy loam, 5 to 8 percent slopes	2, 850	. 5	Olton clay loam, 3 to 5 percent slopes	670	. 1
Bippus clay loam, 0 to 1 percent slopes	3, 220	. 6	Posey complex, 0 to 1 percent slopes	3, 210	. 6
Bippus clay loam, 1 to 3 percent slopes	890	. 2	Posey complex, 1 to 3 percent slopes	3, 650	. 7
Bippus and Spur soils, frequently flooded	1, 430	. 3	Potter soils	570	. 1
Drake soils, 2 to 5 percent slopes	1, 130	. 2	Pullman clay loam, 0 to 1 percent slopes	233, 240	41. 4
Drake soils, 5 to 8 percent slopes	470	. 1	Pullman clay loam, 1 to 3 percent slopes	23, 340	4. 1
Estacado clay loam, 0 to 1 percent slopes	30, 030	5. 3	Randall clay	18, 420	3. 3
Estacado clay loam, 1 to 3 percent slopes	30, 940	5. 5			
Lipan clay	5, 970	1. 1	Total	563, 200	100. 0
Lofton clay loam	6, 320	1. 1			

TABLE 2.—*Predicted average acre yields of principal crops, dryfarmed and irrigated, under high-level management*

[Only the soils commonly used for crops are listed. Absence of data indicates that the particular crop is not grown on the soil named]

Soil	Dryfarmed			Irrigated			
	Wheat	Grain sorghum	Cotton	Wheat	Grain sorghum	Cotton	Alfalfa
	Bu.	*Lb.*	*Lb.*	*Bu.*	*Lb.*	*Lb.*	*Tons*
Acuff loam, 0 to 1 percent slopes	13	1,000	165	55	7,400	850	6
Acuff loam, 1 to 3 percent slopes	13	1,000	145	50	6,600	750	5
Acuff loam, 3 to 5 percent slopes	7	750	120				
Berda fine sandy loam, 3 to 5 percent slopes	6	700		37	3,600		
Bippus clay loam, 0 to 1 percent slopes	15	1,050	165	55	7,400	800	6
Bippus clay loam, 1 to 3 percent slopes	12	800	150	50	6,600	800	5
Drake soils, 2 to 5 percent slopes	9	600		30	3,600	400	4
Estacado clay loam, 0 to 1 percent slopes	12	900	155	55	6,600	850	5
Estacado clay loam, 1 to 3 percent slopes	11	850	145	45	5,700	800	4
Lipan clay	12	700		45	5,700	700	5
Lofton clay loam	15	1,000	165	55	7,600	850	6
Mansker-Estacado loams, 3 to 5 percent slopes	7	500		27	3,500		3
Olton clay loam, 0 to 1 percent slopes	15	1,050	155	55	7,600	850	6
Olton clay loam, 1 to 3 percent slopes	13	900	145	50	6,400	800	5
Olton clay loam, 3 to 5 percent slopes	9	700					
Posey complex, 0 to 1 percent slopes	9	800	120	37	3,900	700	4
Posey complex, 1 to 3 percent slopes	9	800	120	35	3,800	650	4
Pullman clay loam, 0 to 1 percent slopes	14	900	155	55	7,600	850	6
Pullman clay loam, 1 to 3 percent slopes	13	800	150	45	6,700	800	5

TABLE 3.—*Suitability of soils for elements of wildlife habitat and for kinds of wildlife*

[A rating of 1 means well suited; 2, suited; 3, poorly suited; and 4, unsuited. For further explanation of ratings, see text]

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees and shrubs	Wetland food and cover plants	Shallow water developments	Open-land wildlife	Brushland wildlife	Wetland wildlife
Acuff: AcA, AcB, AcC	1	1	1	4	4	4	1	3	4
Berda: BeC, BeD	1	1	1	4	4	4	1	3	4
Bippus: BpA, BpB, Bs	1	1	1	4	4	4	1	3	4
For Spur part of Bs, see Spur series.									
Drake: DrC, DrD	1	1	1	4	4	4	1	3	4
Estacado: EsA, EsB	1	1	1	4	4	4	1	3	4
Lipan: Lc	2	2	2	4	4	3	2	3	3
Lofton: Lo	1	1	1	4	4	4	1	3	4
Mansker: MbD, MeC	2	1	1	4	4	4	1	3	4
For Berda part of MbD, see Berda series; for Estacado part of MeC, see Estacado series.									
Olton: OlA, OlB, OlC	1	1	1	4	4	4	1	3	4
Posey: PoA, PoB	1	1	1	4	4	4	1	3	4
Potter: Pt	4	3	3	4	4	4	3	3	4
Pullman: PuA, PuB	1	1	1	4	4	4	1	3	4
Randall: Ra	3	2	2	4	2	2	2	3	1
Spur	3	2	2	4	4	4	2	3	4
Mapped only in an undifferentiated unit with Bippus soils.									

TABLE 4.—*Estimated soil properties significant in engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series. The symbol < means less than]

Soil series and map symbols	Hydrologic group	Depth from surface	Classification		Classification—Con.	Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
			USDA texture	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
		Inches								*Inches per hour*	*Inches per inch of soil*	*pH*	
Acuff: AcA, AcB, AcC	B	0–10	Loam	CL	A–6	100	100	100	50–65	0. 63–2. 0	0. 14–0. 17	6. 6–7. 3	Low.
		10–36	Sandy clay loam	CL	A–6	100	100	100	65–75	0. 63–2. 0	0. 15–0. 17	6. 6–8. 4	Low.
		36–80	Sandy clay loam	CL	A–6	95–100	95–100	90–95	65–75	0. 63–2. 0	0. 13–0. 15	7. 9–8. 4	Low.
Berda: BeC, BeD	B	0–26	Fine sandy loam	CL	A–6	98–100	95–100	85–95	50–60	0. 63–2. 0	0. 14–0. 15	7. 9–8. 4	Low.
		26–60	Loam	CL	A–6	95–100	95–100	90–95	50–60	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	Low.
*Bippus: BpA, BpB, Bs. For properties of Spur soils in Bs, see Spur series.	B	0–83	Clay loam	CL	A–6	100	95–100	80–90	50–70	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	Low.
Drake: DrC, DrD	B	0–8	Loam	CL	A–6	100	100	70–90	50–60	0. 63–2. 0	0. 13–0. 15	7. 9–8. 4	Low.
		8–27	Clay loam	CL	A–6	100	100	70–90	55–65	0. 63–2. 0	0. 13–0. 15	7. 9–8. 4	Low.
		27–82	Sandy clay loam	SC	A–4	100	100	70–90	40–50	0. 63–2. 0	0. 13–0. 15	7. 9–8. 4	Low.
Estacado: EsA, EsB	B	0–15	Clay loam	CL	A–6	100	98–100	95–100	55–85	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	Low.
		15–25	Clay loam	CL	A–6	100	95–100	85–95	60–90	0. 63–2. 0	0. 15–0. 16	7. 9–8. 4	Low.
		25–80	Clay loam	CL	A–6	100	95–100	95–100	75–90	0. 63–2. 0	0. 13–0. 15	7. 9–8. 4	Low.
Lipan: Lc	D	0–84	Clay	CH	A–7	95–100	95–100	90–100	80–90	<0. 06	0. 15–0. 17	7. 4–8. 4	High.
Lofton: Lo	D	0–9	Clay loam	CL	A–6	100	100	98–100	70–80	0. 20–0. 63	0. 17–0. 18	6. 6–7. 3	Moderate.
		9–44	Clay	CH	A–7	100	100	95–100	70–85	<0. 06	0. 16–0. 18	7. 4–8. 4	High.
		44–80	Clay loam	CL	A–6	100	95–100	90–100	60–70	0. 06–0. 20	0. 14–0. 16	7. 9–8. 4	Moderate.
*Mansker: MbD, MeC. For properties of Berda soils in MbD, see Berda series; for properties of Estacado soils in MeC, see Estacado series.	B	0–9	Loam	CL	A–4	95–100	95–100	85–95	50–60	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	Low.
		9–20	Clay loam	CL	A–4 or A–6	95–100	95–100	90–95	55–65	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	Low.
		20–83	Clay loam	CL	A–6	100	95–100	90–95	50–60	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	Low.
Olton: OlA, OlB, OlC	C	0–13	Clay loam	CL	A–6	100	100	85–95	55–65	0. 63–2. 0	0. 16–0. 18	6. 6–7. 8	Low.
		13–39	Clay loam	CL	A–6	100	100	95–100	70–80	0. 20–0. 63	0. 16–0. 18	7. 4–8. 4	Moderate.
		39–80	Clay loam	CL	A–6	95–100	95–100	90–95	60–70	0. 20–0. 63	0. 14–0. 15	7. 9–8. 4	Moderate.
Posey: PoA, PoB	B	0–9	Loam	SC or CL	A–4 or A–6	100	95–100	85–95	45–60	0. 63–2. 0	0. 13–0. 17	7. 9–8. 4	Low.
		9–85	Clay loam	CL	A–6	95–100	90–95	85–95	55–70	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	Low.
Potter: Pt	C	0–9	Loam	ML or CL	A–4	80–95	70–95	60–85	50–60	0. 63–2. 0	0. 12–0. 15	7. 9–8. 4	Low.
		9–50	Slightly platy caliche (too variable to rate).										
Pullman: PuA, PuB	D	0–8	Clay loam	CL	A–6	100	100	95–100	80–90	0. 20–0. 63	0. 15–0. 18	6. 6–7. 3	Moderate.
		8–46	Clay	CH	A–7	100	100	95–100	85–95	<0. 06	0. 15–0. 16	6. 6–8. 4	High.
		46–84	Silty clay loam	CL or CH	A–7	100	100	95–100	80–95	0. 06–0. 20	0. 14–0. 16	7. 9–8. 4	Moderate.
Randall: Ra	D	0–120	Clay	CH	A–7	100	100	96–100	80–95	<0. 06	0. 15–0. 17	6. 6–8. 4	High.
Spur. Mapped only in an undifferentiated unit with Bippus soils.	B	0–48	Clay loam	CL	A–6	100	95–100	95–100	75–90	0. 63–2. 0	0. 13–0. 14	7. 9–8. 4	Low.
		48–80	Sandy clay loam	CL	A–6	100	95–100	95–100	70–80	0. 63–2. 0	0. 12–0. 14	7. 9–8. 4	Low.

TABLE 5.—*Engineering interpretations for farm and ranch uses*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series]

Soil series and map symbols	Limitations for farm ponds		Soil features affecting—		
	Reservoir areas	Embankments	Irrigation	Terraces and diversions	Grassed waterways
Acuff: AcA, AcB, AcC	Moderate: moderate permeability.	Moderate: fair stability where sloping.	All features favorable.	All features favorable.	All features favorable.
Berda: BeC, BeD	Severe: seepage; calcareous substratum.	Moderate: fair resistance to piping and erosion.	Slope	Erosion hazard	Erosion hazard.
*Bippus: BpA, BpB, Bs. For properties of Spur soils in Bs, see Spur series.	Moderate: moderate permeability.	Moderate: fair resistance to piping and erosion.	Flood hazard	Flood hazard	Flood hazard.
Drake: DrC, DrD	Severe: seepage; calcareous substratum.	Moderate: fair resistance to piping and erosion.	Erosion hazard	Erosion hazard	Erosion hazard.
Estacado: EsA, EsB	Moderate: moderate permeability.	Moderate: fair stability where sloping.	All features favorable.	Erosion hazard	Erosion hazard.
Lipan: Lc	Slight	Moderate: fair stability where sloping.	Very slow permeability.	All features favorable.	All features favorable.
Lofton: Lo	Slight	Moderate: fair stability where sloping.	Very slow permeability.	All features favorable.	All features favorable.
*Mansker: MbD, MeC. For properties of Berda soils in MbD, see Berda series; for Estacado soils in MeC, see Estacado series.	Moderate: moderate permeability.	Moderate: fair stability where sloping.	Slope	Erosion hazard	Erosion hazard.
Olton: OlA, OlB, OlC	Moderate: moderately slow permeability.	Moderate: fair resistance to piping and erosion.	All features favorable.	All features favorable.	All features favorable.
Posey: PoA, PoB	Moderate: moderate permeability.	Moderate: fair stability where sloping.	All features favorable.	Erosion hazard	Erosion hazard.
Potter: Pt	Severe: seepage; calcareous substratum.	Severe: 5 to 10 inches of material.	Slightly platy caliche at a depth of 5 to 10 inches.	Slightly platy caliche at a depth of 5 to 10 inches.	Slightly platy caliche at a depth of 5 to 10 inches.
Pullman: PuA, PuB	Slight	Moderate: fair stability where sloping.	Very slow permeability.	All features favorable.	All features favorable.
Randall: Ra	Slight	Moderate: fair stability where sloping.	Flood hazard	Flood hazard	Flood hazard.
Spur. Mapped only in an undifferentiated unit with Bippus soils.	Moderate: moderate permeability.	Moderate: fair stability where sloping; fair resistance to piping and erosion.	Flood hazard	Flood hazard	Flood hazard.

TABLE 6.—*Interpretations for highways, buildings, and recreational facilities*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series]

Soil series and map symbols	Suitability as a source of—		Limitations for highways and buildings		Limitations for highways and buildings—Continued		Limitations for recreational facilities				Corrosivity (uncoated steel)
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons	Camp areas	Picnic areas	Playgrounds	Paths and trails	
Acuff: AcA, AcB, AcC	Fair: 10 to 12 inches of loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight	Slight	Moderate: moderate permeability.	Slight	Slight	Slight: 0 to 2 percent slopes. Moderate: 2 to 5 percent slopes.	Slight	Moderate: sandy clay loam texture.
Berda: BeC, BeD	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight	Slight: 3 to 5 percent slopes. Moderate 5 to 8 percent slopes.	Severe: seepage; calcareous substratum.	Slight	Slight	Moderate: 3 to 6 percent slopes. Severe: 6 to 8 percent slopes.	Slight	Moderate: conductivity.
*Bippus: BpA, BpB, Bs. For properties of Spur soils in Bs, see Spur series.	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Severe: flood hazard.	Severe: flood hazard.	Moderate: moderate permeability.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture; 2 to 3 percent slopes.	Moderate: clay loam texture.	Moderate: clay loam texture.
Drake: DrC, DrD	Fair: 15 to 30 percent calcium carbonate equivalent.	Fair: fair traffic-supporting capacity	Moderate: fair traffic-supporting capacity.	Slight	Slight: 2 to 5 percent slopes. Moderate: 5 to 8 percent slopes.	Severe: seepage; calcareous substratum.	Moderate: dust.	Moderate: dust.	Moderate: dust; 2 to 6 percent slopes. Severe: 6 to 8 percent slopes.	Moderate: dust.	High: conductivity.
Estacado: EsA, EsB	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight	Slight	Moderate: moderate permeability; 2 to 5 percent slopes.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.
Lipan: Lc	Poor: clay texture.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight	Severe: very slow permeability; clay texture.	Severe: clay texture.	Severe: very slow permeability; clay texture.	Severe: clay texture.	High: clay texture.
Lofton: Lo	Fair: clay loam texture.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight	Severe: very slow permeability.	Moderate: clay loam texture.	Severe: very slow permeability.	Moderate: clay loam texture.	High: clay texture.
*Mansker: MbD, MeC. For properties of Berda soils in MbD, see Berda series, for Estacado soils in MeC, see Estacado series.	Fair: 7 to 12 inches loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight	Slight: 3 to 5 percent slopes. Moderate: 5 to 8 percent slopes.	Moderate: moderate permeability; 2 to 7 percent slopes. Severe: 7 to 8 percent slopes.	Slight	Slight	Moderate: 2 to 6 percent slopes. Severe: 6 to 8 percent slopes.	Slight	Moderate: clay loam texture.
Olton: OlA, OlB, OlC	Fair: clay loam texture.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.	Slight: 0 to 2 percent slopes. Moderate: 2 to 5 percent slopes.	Moderate: moderately slow permeability; clay loam texture.	Moderate: clay loam texture.	Moderate: moderately slow permeability; clay loam texture; 2 to 5 percent slopes.	Moderate: clay loam texture.	Moderate: clay loam texture.
Posey: PoA, PoB	Fair: 6 to 10 inches of loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight	Slight	Moderate: moderate permeability.	Slight	Slight	Slight: 0 to 2 percent slopes. Moderate: 2 to 3 percent slopes.	Slight	Moderate: clay loam texture.
Potter: Pt	Poor: 15 to 35 percent coarse fragments.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight	Slight: 3 to 5 percent slopes. Moderate: 5 to 8 percent slopes.	Severe: seepage; calcareous substratum.	Slight	Slight	Moderate: 3 to 6 percent slopes. Severe: 6 to 8 percent slopes.	Slight	Moderate: conductivity.

TABLE 6.—*Interpretations for highways, buildings, and recreational facilities*—Continued

Soil series and map symbols	Suitability as a source of—		Limitations for highways and buildings		Limitations for highways and buildings—Continued		Limitations for recreational facilities				Corrosivity (uncoated steel)
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons	Camp areas	Picnic areas	Playgrounds	Paths and trails	
Pullman: PuA, PuB	Fair: clay loam texture.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight	Moderate: very slow permeability; clay loam texture.	Moderate: clay loam texture.	Moderate: very slow permeability; clay loam texture.	Moderate: clay loam texture.	High: clay texture.
Randall: Ra	Poor: clay texture.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential; flood hazard.	Severe: high shrink-swell potential; flood hazard.	Severe: very slow permeability; flood hazard.	Slight	Severe: somewhat poorly drained; clay texture.	Severe: somewhat poorly drained; clay texture.	Severe: somewhat poorly drained; very slow permeability; clay texture.	Severe: somewhat poorly drained; clay texture.	High: clay texture; poorly drained.
Spur Mapped only in an undifferentiated unit with Bippus soils.	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Severe: flood hazard.	Severe: flood hazard.	Severe: flood hazard.	Moderate: moderate permeability.	Severe: flood hazard.	Moderate: flood hazard; clay loam texture.	Severe: flood hazard.	Moderate: clay loam texture.	Moderate: clay loam texture

TABLE 7.—*Classification of soil series*

Series	Family	Subgroup	Order
Acuff	Fine-loamy, mixed, thermic	Aridic Paleustolls	Mollisols.
Berda	Fine-loamy, mixed, thermic	Aridic Ustochrepts	Inceptisols.
Bippus	Fine-loamy, mixed, thermic	Cumulic Haplustolls	Mollisols.
Drake	Fine-loamy, mixed (calcareous), thermic	Typic Ustorthents	Entisols.
Estacado	Fine-loamy, mixed, thermic	Calciorthidic Paleustolls	Mollisols.
Lipan	Fine, montmorillonitic, thermic	Entic Pellusterts	Vertisols.
Lofton	Fine, mixed, thermic	Torrertic Argiustolls	Mollisols.
Mansker	Fine-loamy, carbonatic, thermic	Calciorthidic Paleustolls	Mollisols.
Olton	Fine, mixed, thermic	Aridic Paleustolls	Mollisols.
Posey	Fine-loamy, mixed, thermic	Calciorthidic Paleustalfs	Alfisols.
Potter	Loamy, carbonatic, thermic, shallow	Ustollic Calciorthids	Aridisols.
Pullman	Fine, mixed, thermic	Torrertic Paleustolls	Mollisols.
Randall	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Spur	Fine-loamy, mixed, thermic	Fluventic Haplustolls	Mollisols.

TABLE 8.—*Temperature and precipitation data*

[Data recorded at Dimmitt, Texas, elevation 3,855 feet. Period of record 1939–68, unless otherwise indicated. The symbol < means less than]

Month	Temperature [1]				Precipitation				Precipitation—Continued										
						Probability of receiving specified amounts during month			Probability of receiving specified amounts during month—Continued					Average number of days with—			Snow and sleet		
	Average daily maximum	Average monthly maximum	Average daily minimum	Average monthly minimum	Average total	None or trace	0.5 inch or more	1 inch or more	2 inches or more	3 inches or more	4 inches or more	5 inches or more	6 inches or more	0.1 inch or more [2]	0.5 inch or more [2]	1 inch or more [2]	Average total [2]	Monthly maximum [2]	Greatest depth
	°F.	°F.	°F.	°F.	In.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.				In.	In.	In.
January	53.0	72.0	19.9	1.5	0.53	3	45	23	5	1	<1	<1	<1	2	(3)	0	3.2	11.5	0
February	53.6	73.3	21.6	8.0	.46	7	38	15	3	<1	<1	<1	<1	2	(3)	0	4.9	13.0	12
March	64.8	84.5	29.8	12.0	.57	10	47	28	8	3	1	<1	<1	2	(3)	0	1.7	11.0	----------
April	74.3	89.5	40.3	27.3	1.05	<1	70	43	18	7	3	<1	<1	2	(3)	0	.1	1.0	(4)
May	81.0	96.3	49.4	36.3	2.18	<1	94	84	59	40	28	18	10	3	1	(3)	0	0	0
June	86.8	97.3	58.5	48.0	3.05	1	90	72	52	32	20	10	8	6	3	1	0	0	0
July	91.3	98.4	63.1	56.9	2.71	<1	87	70	45	24	13	8	4	5	2	1	0	0	0
August	88.4	98.6	60.2	52.7	2.15	1	90	70	45	28	12	8	5	5	2	1	0	0	0
September	82.2	94.3	53.8	41.4	1.68	3	80	56	33	20	10	5	2	4	1	(3)	0	0	0
October	76.3	90.4	42.1	31.4	1.83	5	72	72	30	20	10	5	2	3	1	1	(4)	(4)	0
November	63.5	81.1	32.5	19.7	.63	21	40	20	5	1	<1	<1	<1	2	(3)	(3)	.4	1.5	----------
December	53.4	73.1	22.6	6.4	.66	9	43	22	6	2	<1	<1	<1	2	(3)	(3)	1.9	7.0	----------
Year	72.4	87.4	41.2	28.5	17.50	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	12.2	13.0	----------

[1] Period of record, June 1962–December 1968.
[2] Average length of record, 10 years.
[3] Less than half a day.
[4] Trace; an amount too small to be measured.

NRCS Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

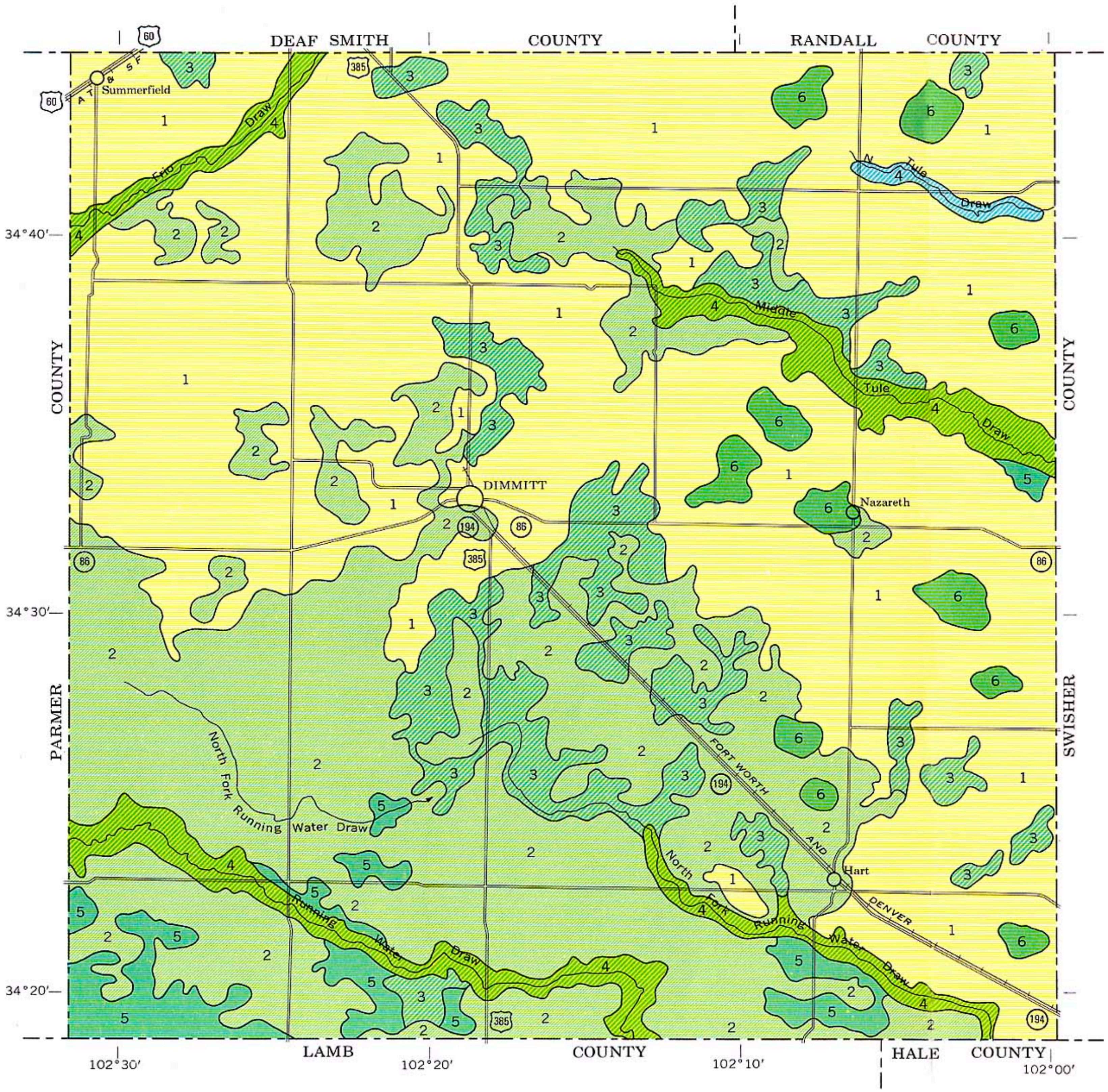
GENERAL SOIL MAP

CASTRO COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

N



SOIL ASSOCIATIONS*

1 Pullman association: Nearly level to gently sloping, deep, noncalcareous, very slowly permeable, loamy soils on uplands

2 Olton association: Nearly level to gently sloping, deep, noncalcareous, moderately slowly permeable, loamy soils on uplands

3 Estacado association: Nearly level to gently sloping, deep, calcareous, moderately permeable, loamy soils on uplands

4 Estacado-Berda-Bippus association: Nearly level to sloping, deep, calcareous, moderately permeable, loamy soils on side slopes and bottom lands

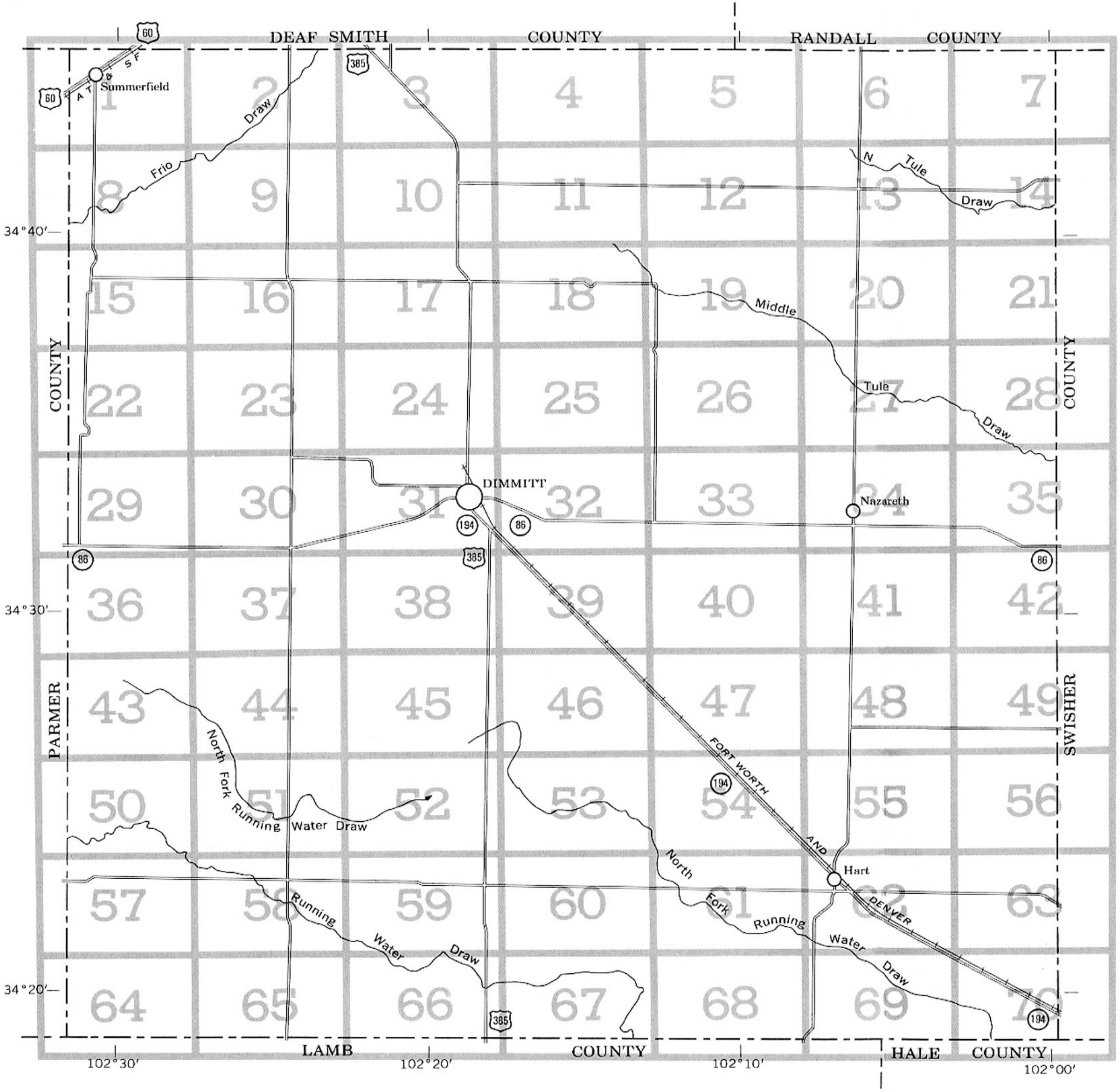
5 Acuff association: Nearly level to gently sloping, deep, noncalcareous, moderately permeable, loamy soils on uplands

6 Lipan-Estacado association: Nearly level to gently sloping, deep, calcareous, very slowly to moderately permeable, clayey and loamy soils in large basins

* Texture given in the title refers to texture of the surface layer of the major soils in each association.

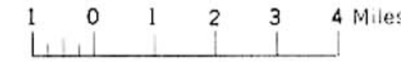
Compiled 1972

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS
CASTRO COUNTY, TEXAS

Scale 1:253,440



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, or D, indicates the class of slope. Most symbols without a slope letter are those of nearly level soils, but some are for soils that have a considerable range of slope.

SYMBOL	NAME
AcA	Acuff loam, 0 to 1 percent slopes
AcB	Acuff loam, 1 to 3 percent slopes
AcC	Acuff loam, 3 to 5 percent slopes
BeC	Berda fine sandy loam, 3 to 5 percent slopes
BeD	Berda fine sandy loam, 5 to 8 percent slopes
BpA	Bippus clay loam, 0 to 1 percent slopes
BpB	Bippus clay loam, 1 to 3 percent slopes
Bs	Bippus and Spur soils, frequently flooded
DrC	Drake soils, 2 to 5 percent slopes
DrD	Drake soils, 5 to 8 percent slopes
EsA	Estacado clay loam, 0 to 1 percent slopes
EsB	Estacado clay loam, 1 to 3 percent slopes
Lc	Lipan clay
Lo	Lofton clay loam
MbD	Mansker-Berda loams, 5 to 8 percent slopes
MeC	Mansker-Estacado loams, 3 to 5 percent slopes
OlA	Olton clay loam, 0 to 1 percent slopes
OlB	Olton clay loam, 1 to 3 percent slopes
OlC	Olton clay loam, 3 to 5 percent slopes
PoA	Posey complex, 0 to 1 percent slopes
PoB	Posey complex, 1 to 3 percent slopes
Pt	Potter soils
PuA	Pullman clay loam, 0 to 1 percent slopes
PuB	Pullman clay loam, 1 to 3 percent slopes
Ra	Randall clay

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State, farm or ranch

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Cotton gin

Windmill

Located object

BOUNDARIES

National or state

County

Minor civil division

Reservation

Land grant

Small park, cemetery, airport

Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Unclassified

Canals and ditches

Lakes and ponds
- Perennial — water, w
- Intermittent — int

Spring

Marsh or swamp

Well, irrigation

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary and symbol — Dx

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

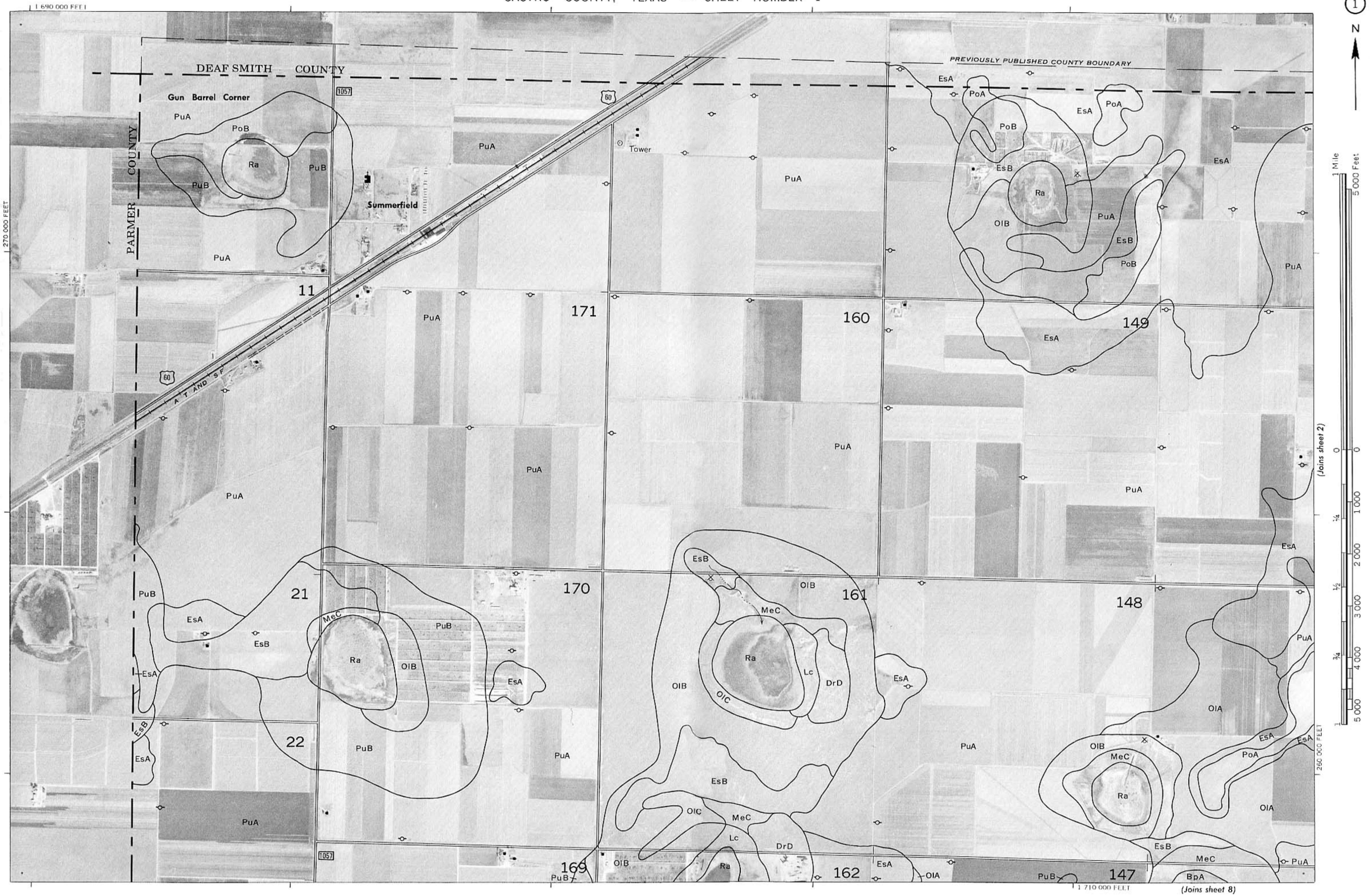
Blowout, wind erosion

Gully

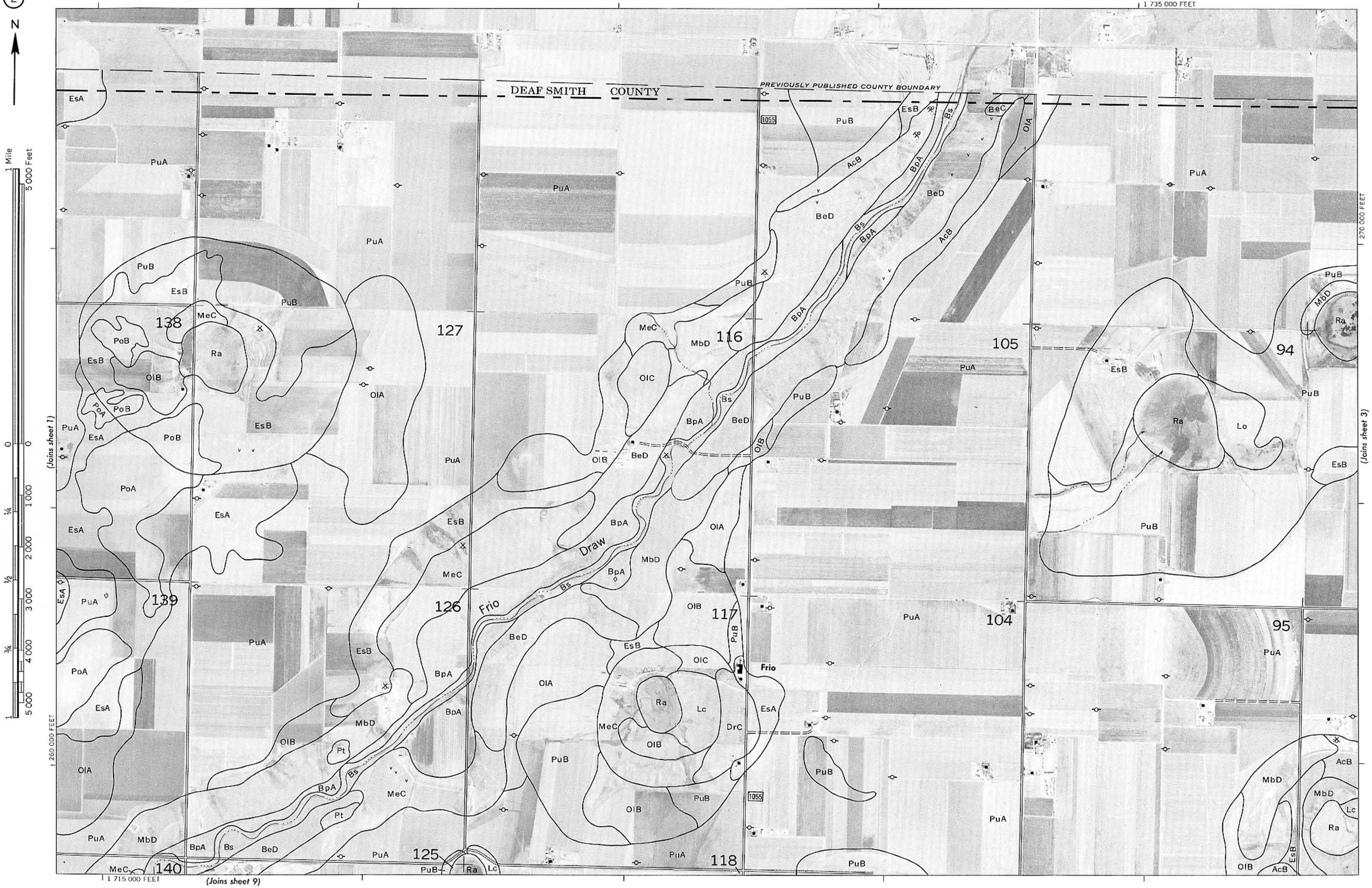
Borrow pit — B.P.

Caliche pit — C.P.

CASTRO COUNTY, TEXAS — SHEET NUMBER 1



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



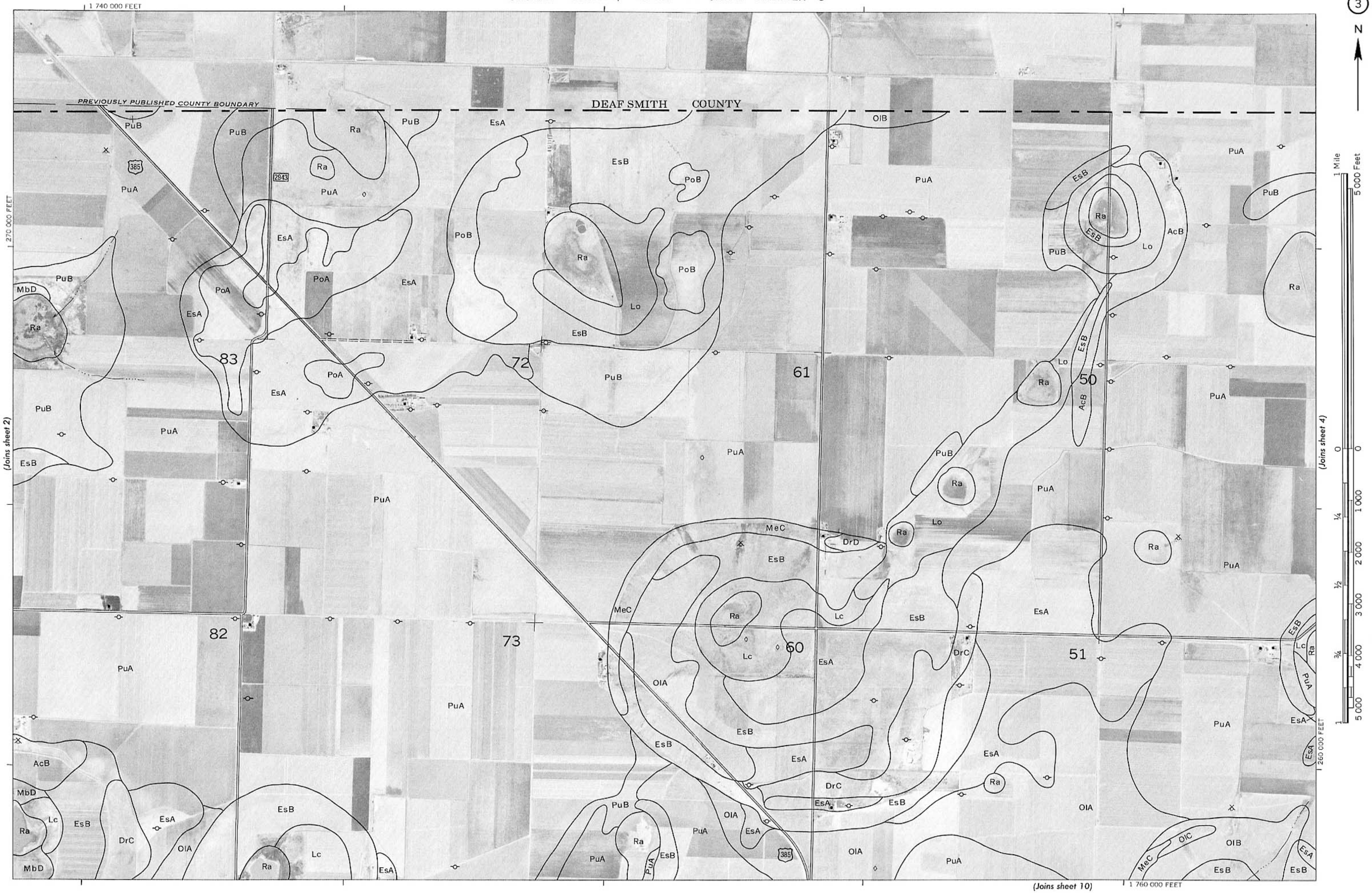
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 2

CASTRO COUNTY, TEXAS — SHEET NUMBER 3



CASTRO COUNTY, TEXAS NO. 3

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

(4)

CASTRO COUNTY, TEXAS — SHEET NUMBER 4

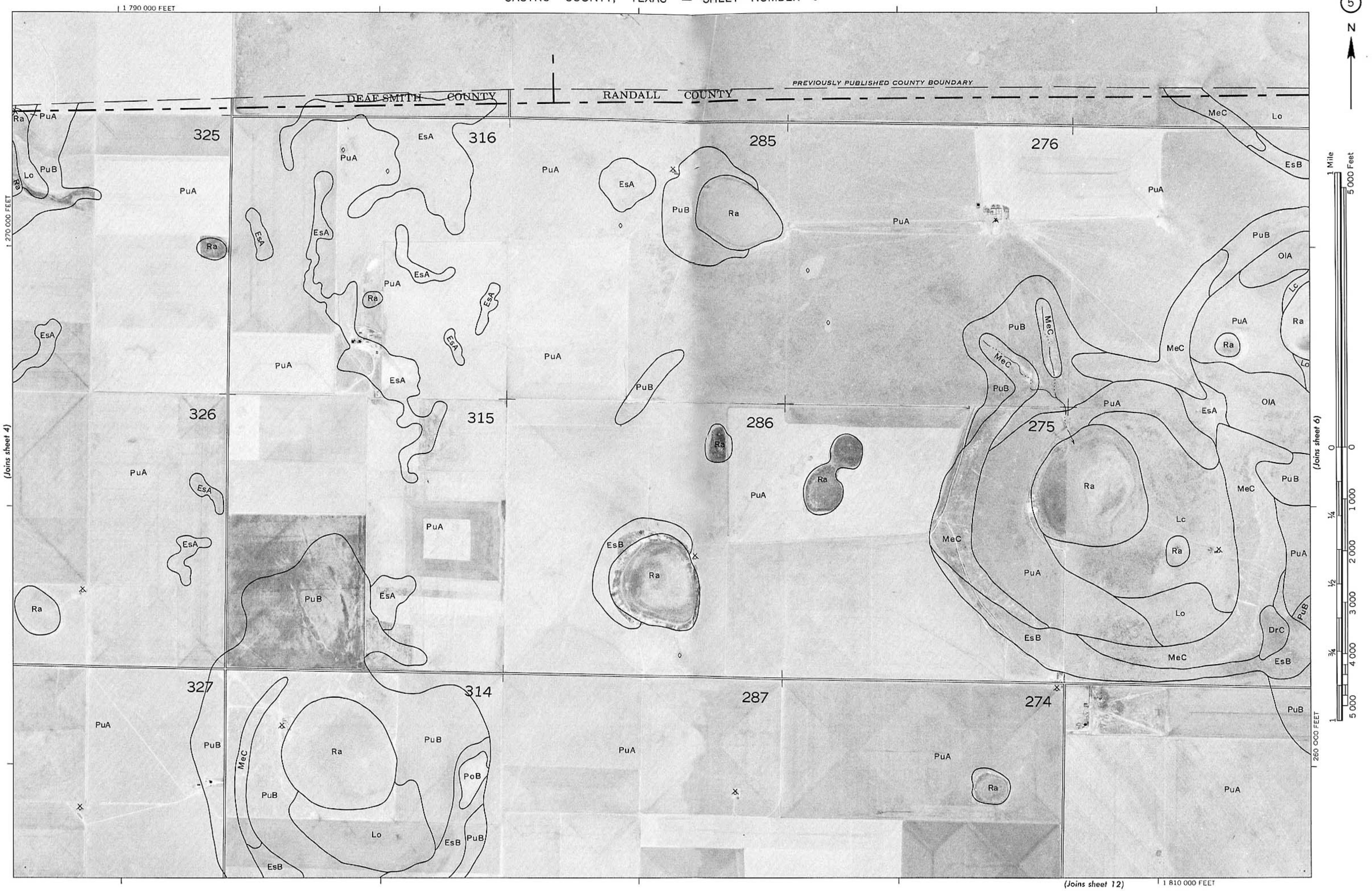
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 4

CASTRO COUNTY, TEXAS — SHEET NUMBER 5

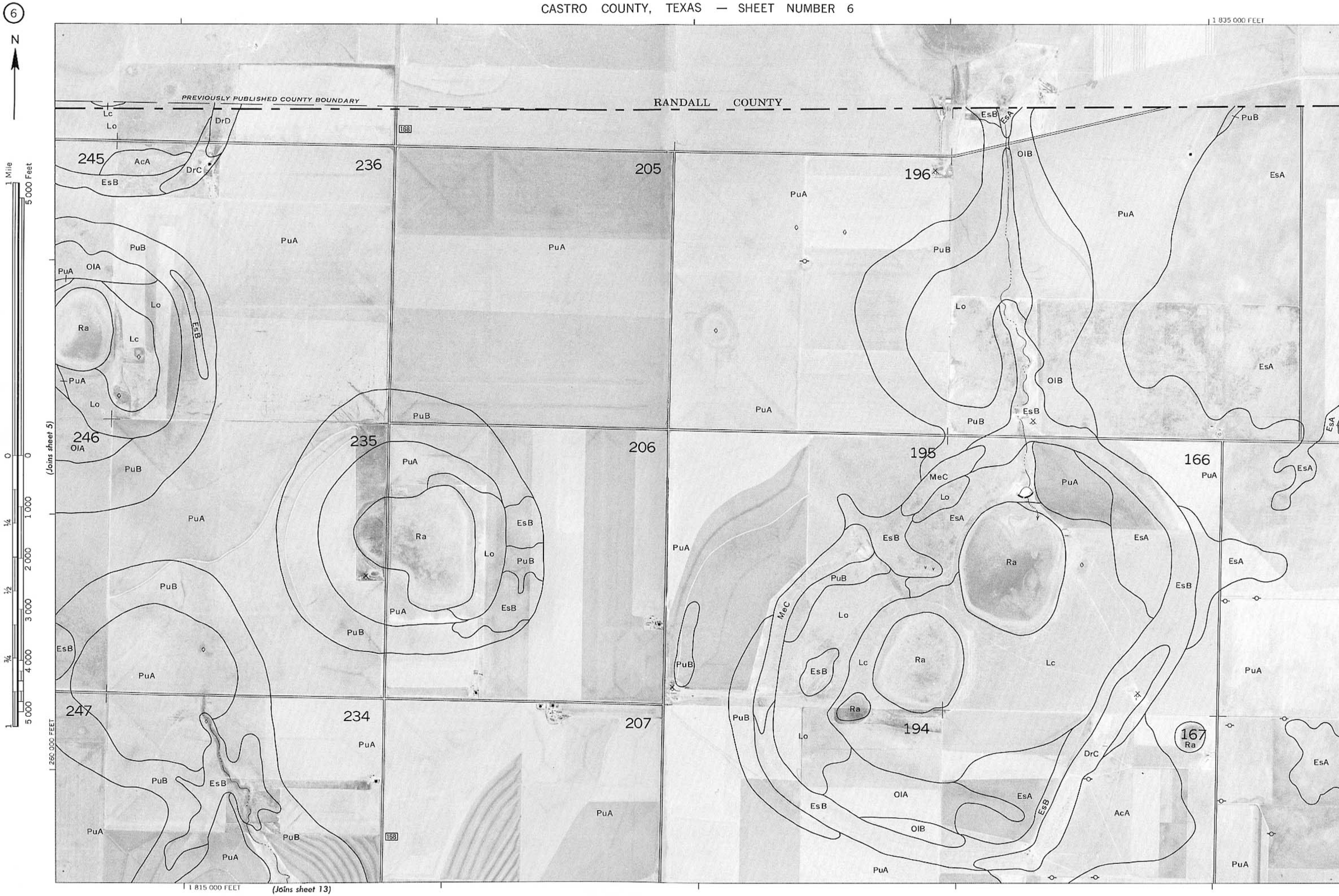


CASTRO COUNTY, TEXAS NO. 5

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

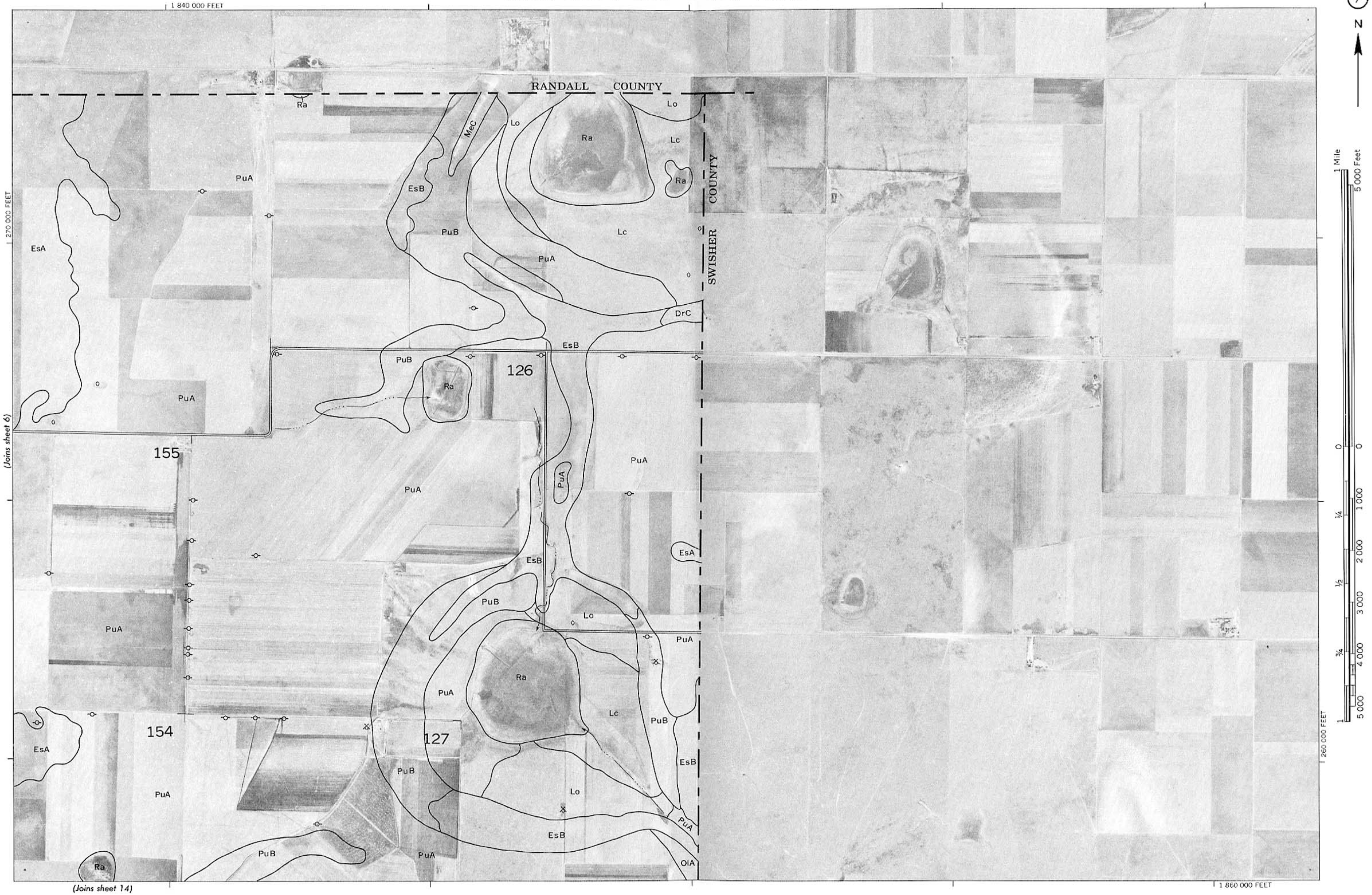
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



CASTRO COUNTY, TEXAS NO. 7

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 8

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

9

N

(Joins sheet 2)

1 715 000 FEET

255 000 FEET

245 000 FEET

1 735 000 FEET

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 16)

1 Mile

5 000 Feet

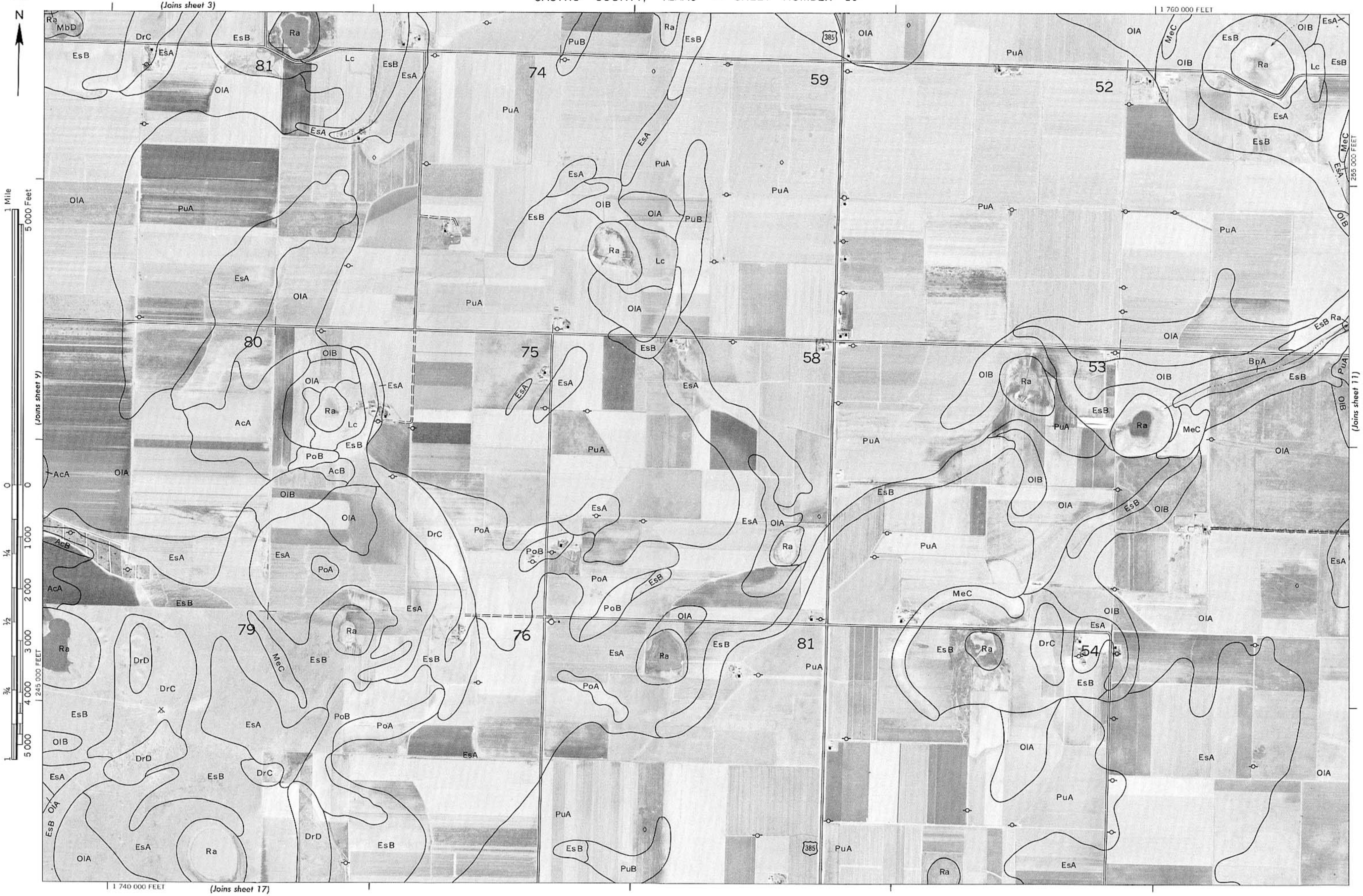
0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

CASTRO COUNTY, TEXAS NO. 9

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

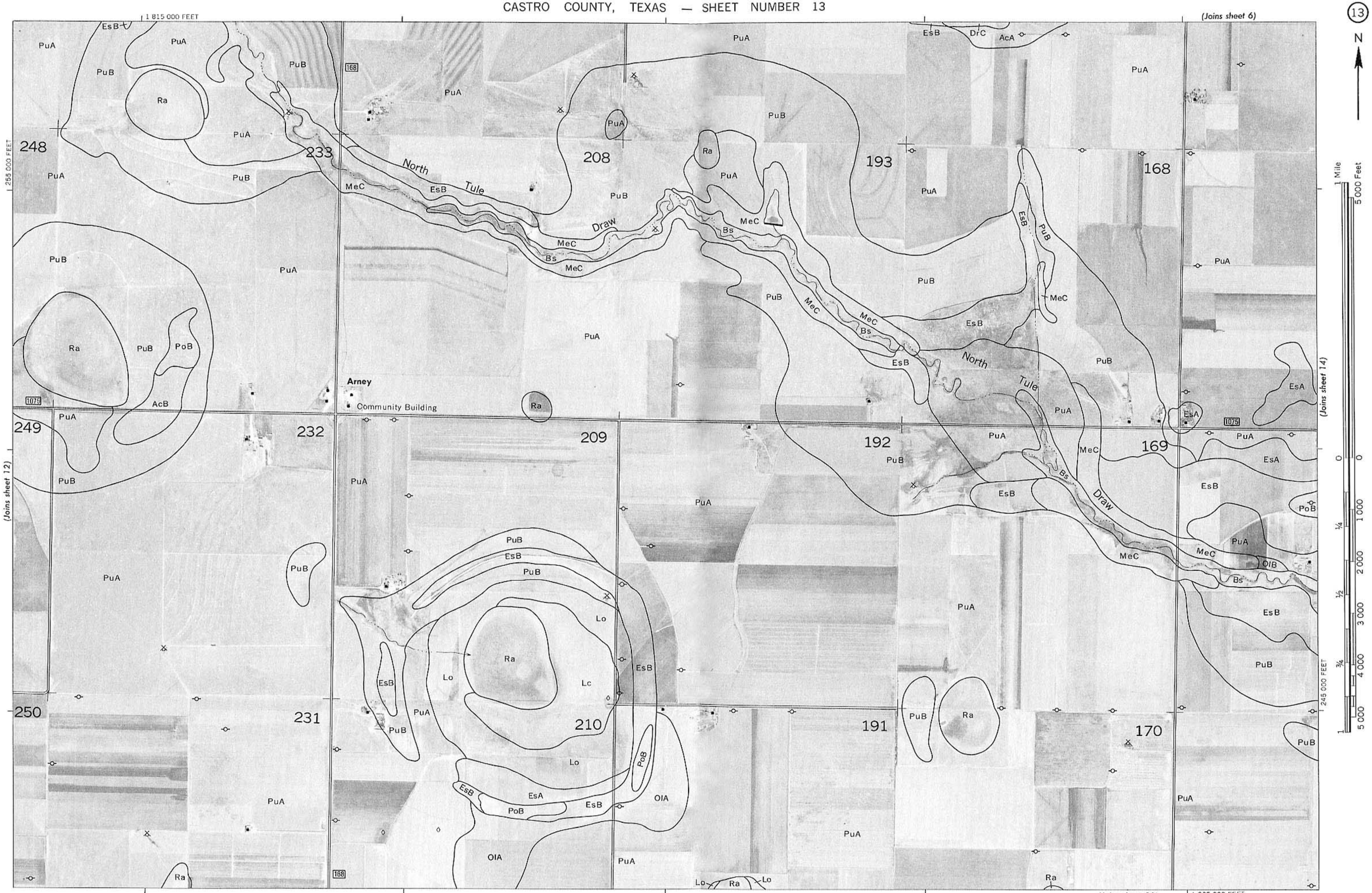
CASTRO COUNTY, TEXAS — SHEET NUMBER 10



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



CASTRO COUNTY, TEXAS NO. 13
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 12

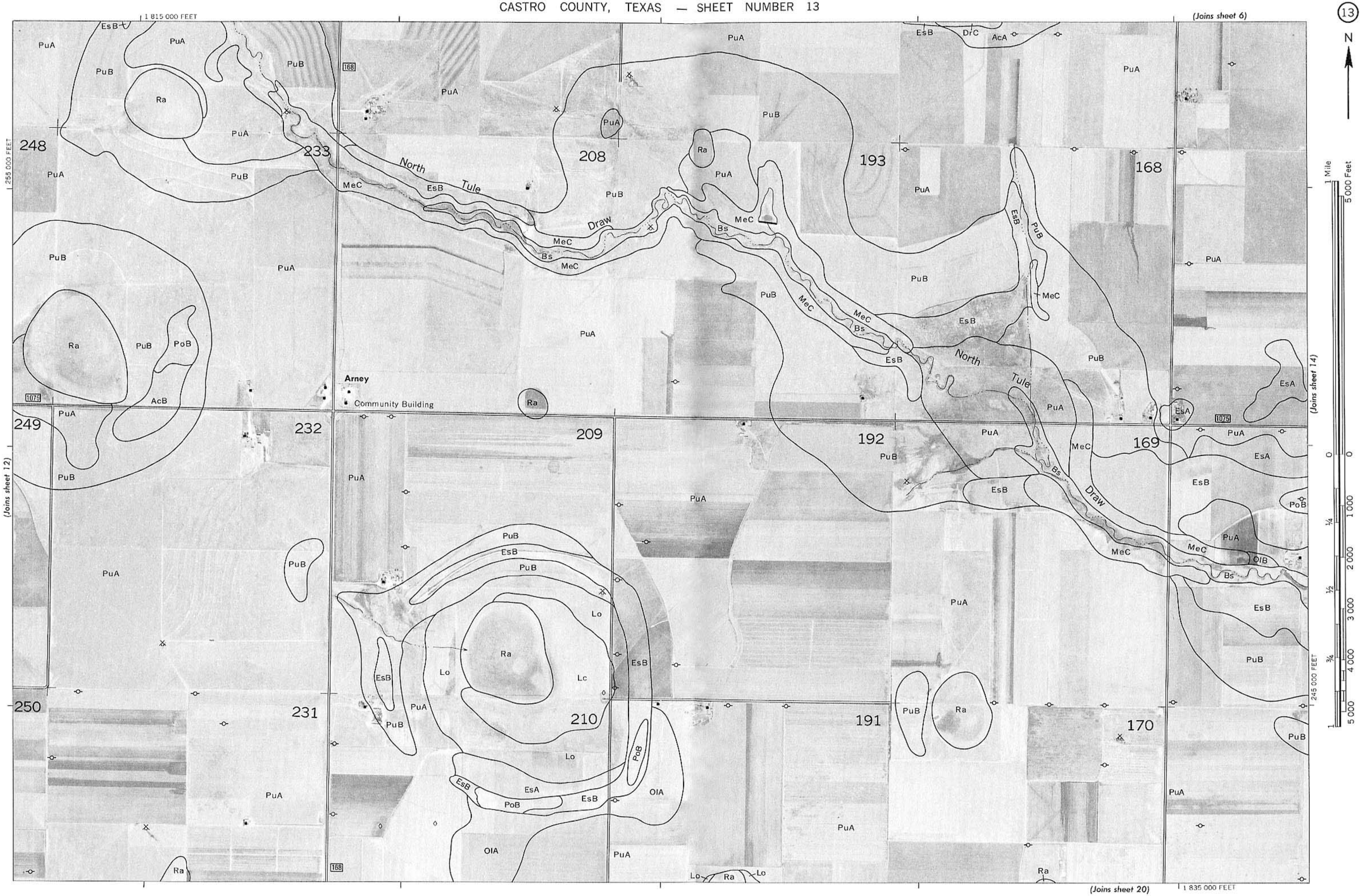
N

1 Mile
5 000 Feet
0 1/4 1/2 3/4 1
0 1 000 2 000 3 000 4 000 5 000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

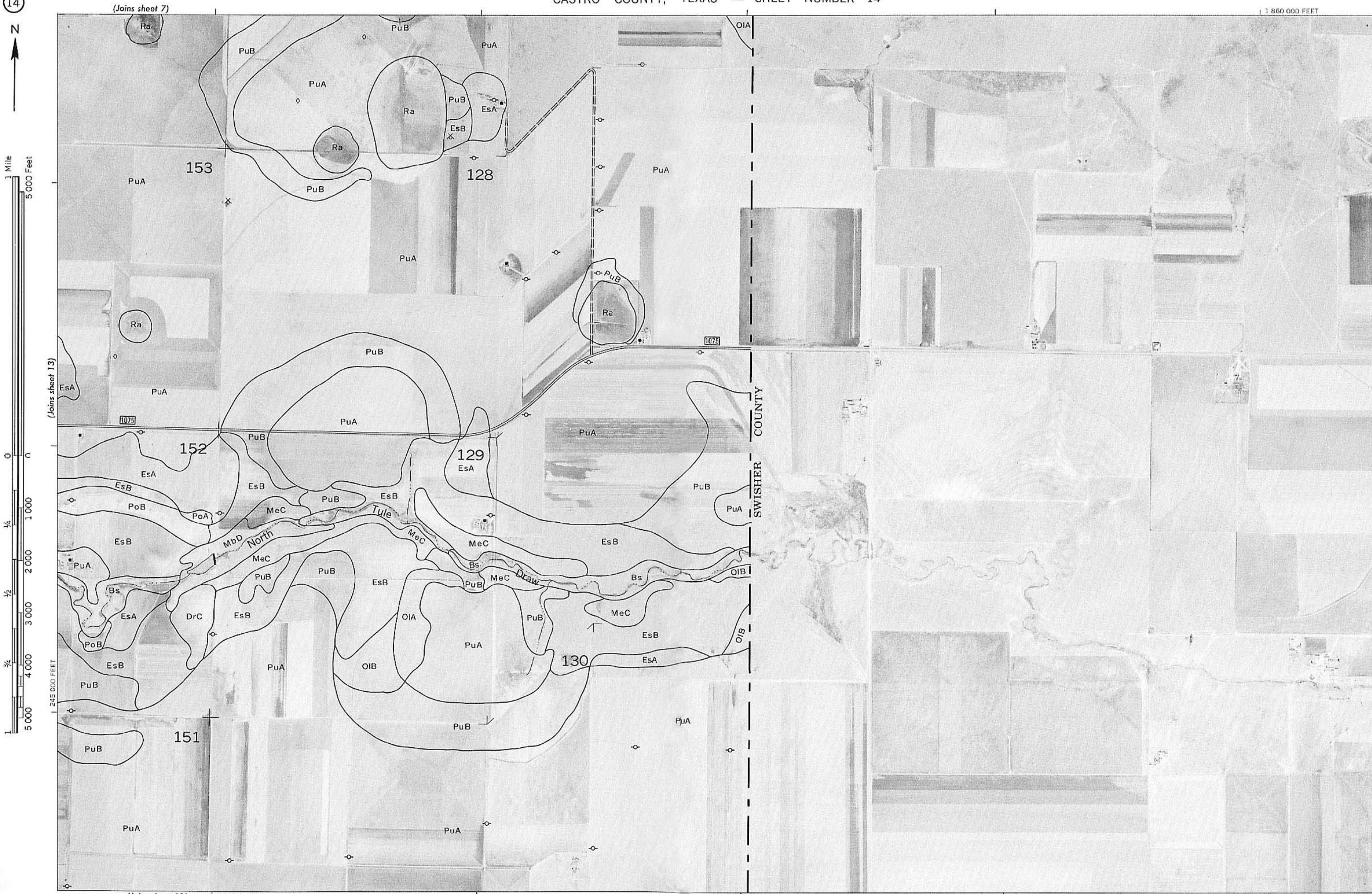
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



CASTRO COUNTY, TEXAS NO. 13

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 14



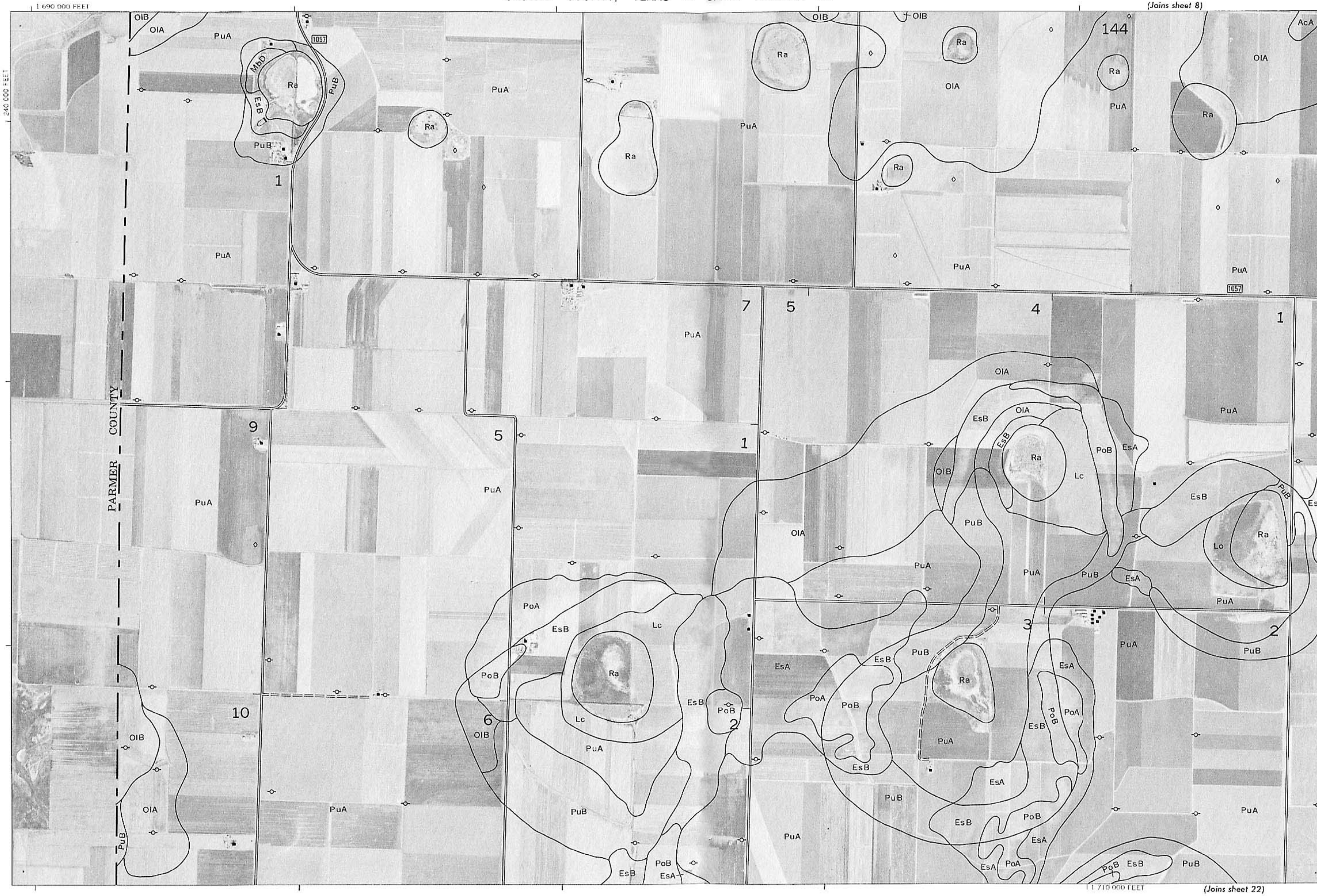
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 15

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



N

15

1 Mile
5 000 Feet
0 ¼ ½ ¾ 1
0 1 000 2 000 3 000 4 000 5 000

CASTRO COUNTY, TEXAS — SHEET NUMBER 16

Land division corners are approximately positioned on this map.

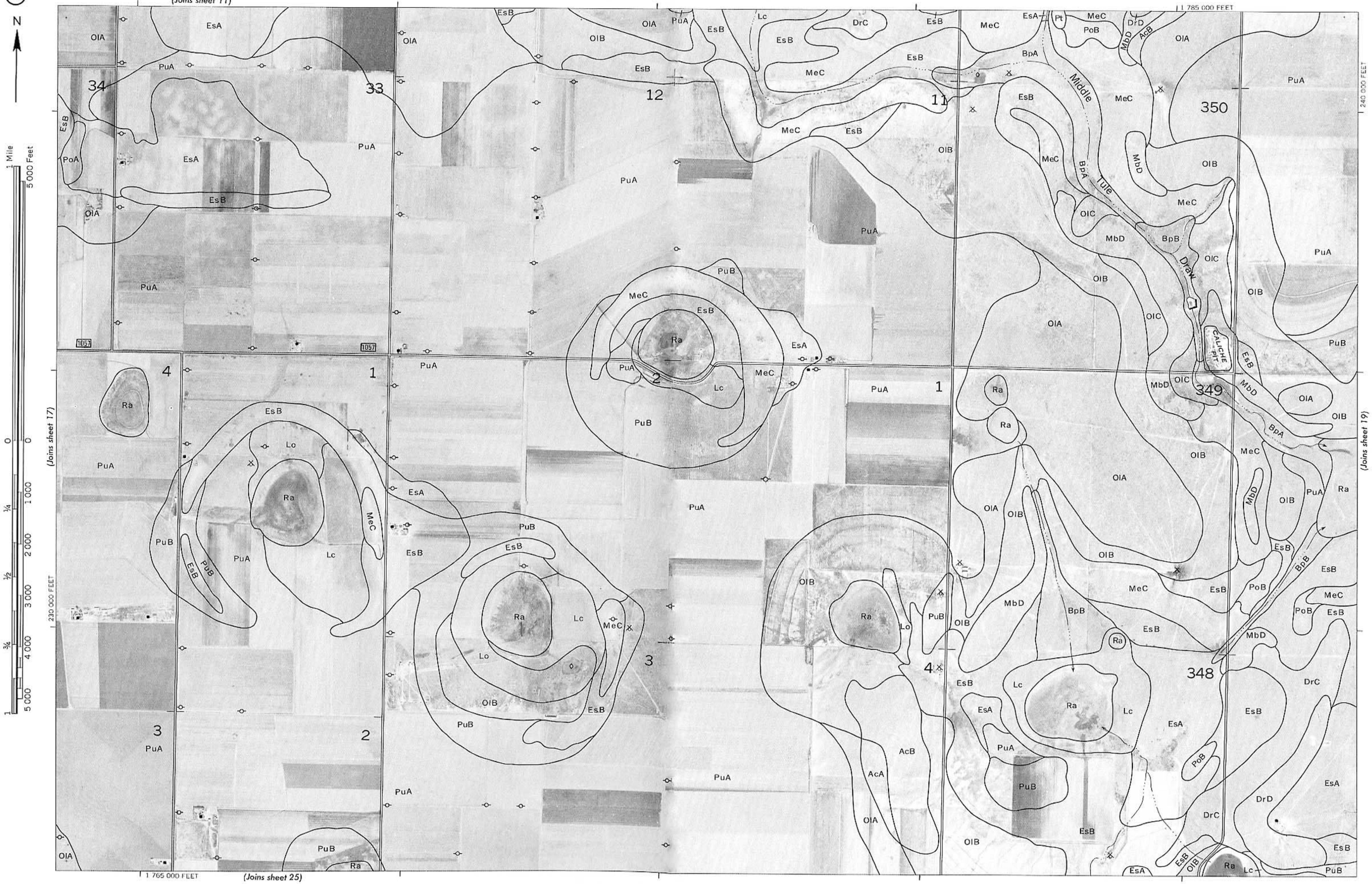
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 17

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 18



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

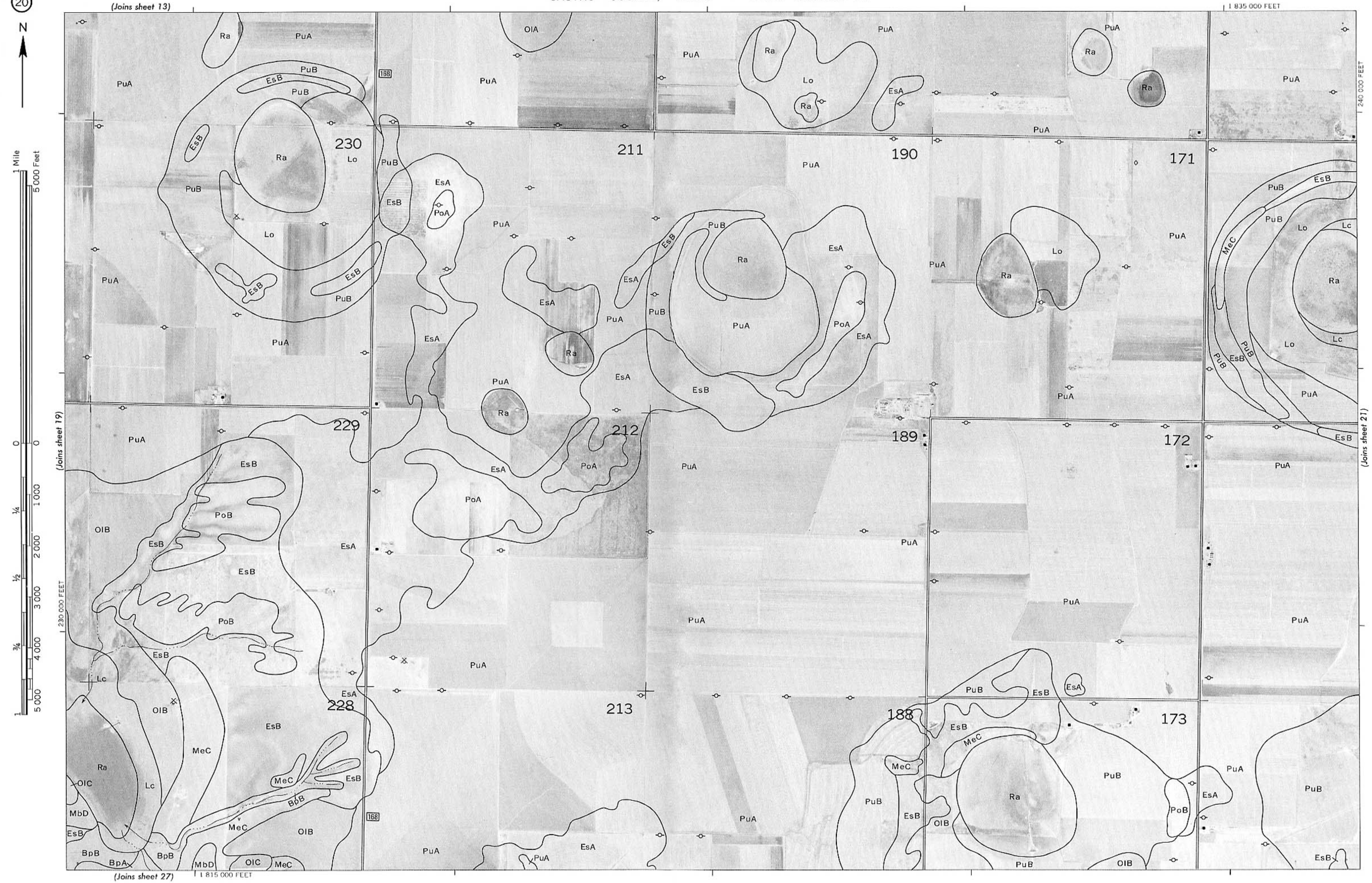
CASTRO COUNTY, TEXAS — SHEET NUMBER 19

CASTRO COUNTY, TEXAS NO. 19

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 20

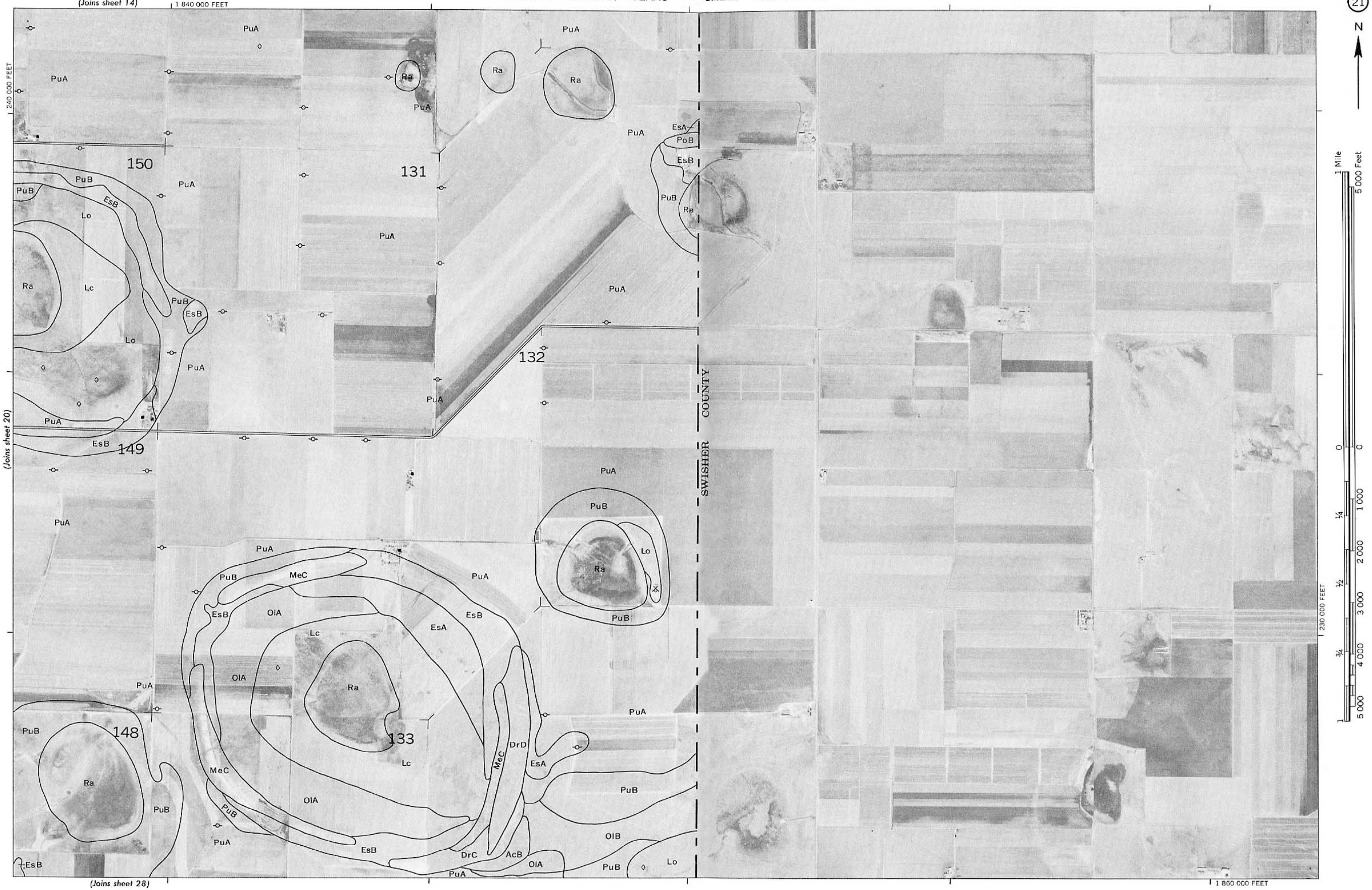


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS — SHEET NUMBER 21



CASTRO COUNTY, TEXAS NO. 21

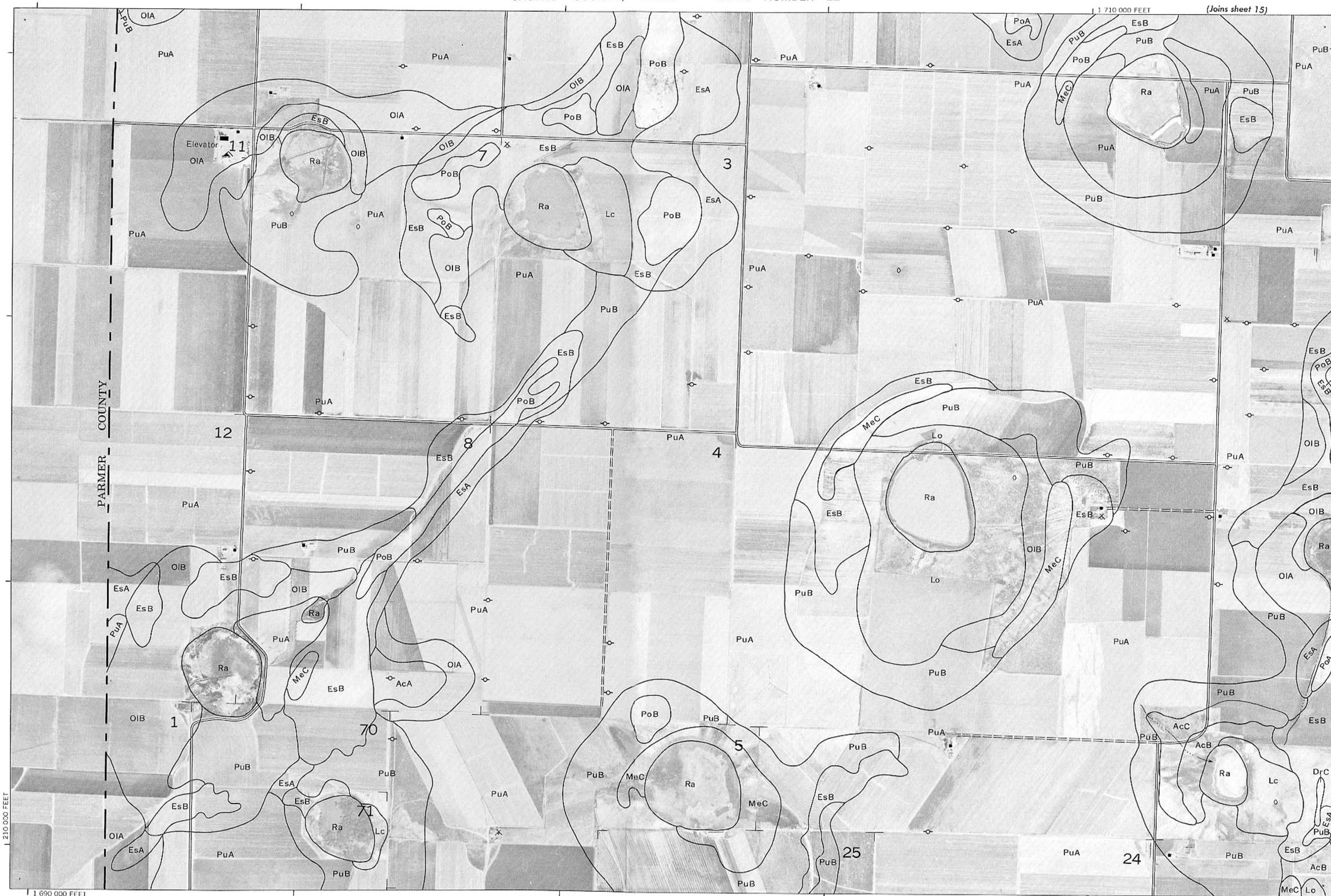
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

(22)

CASTRO COUNTY, TEXAS — SHEET NUMBER 22



N

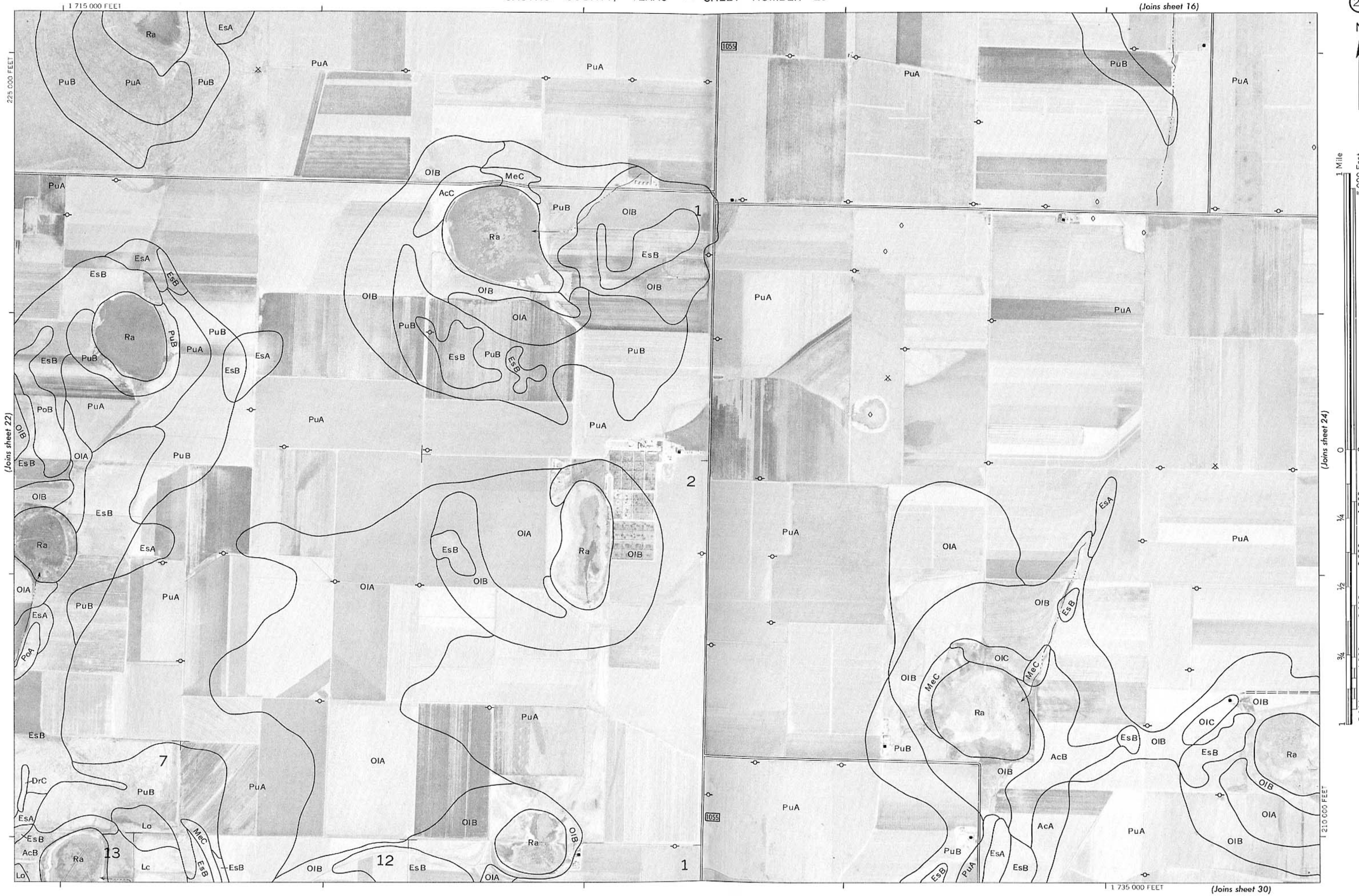
1 Mile
5 000 Feet
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

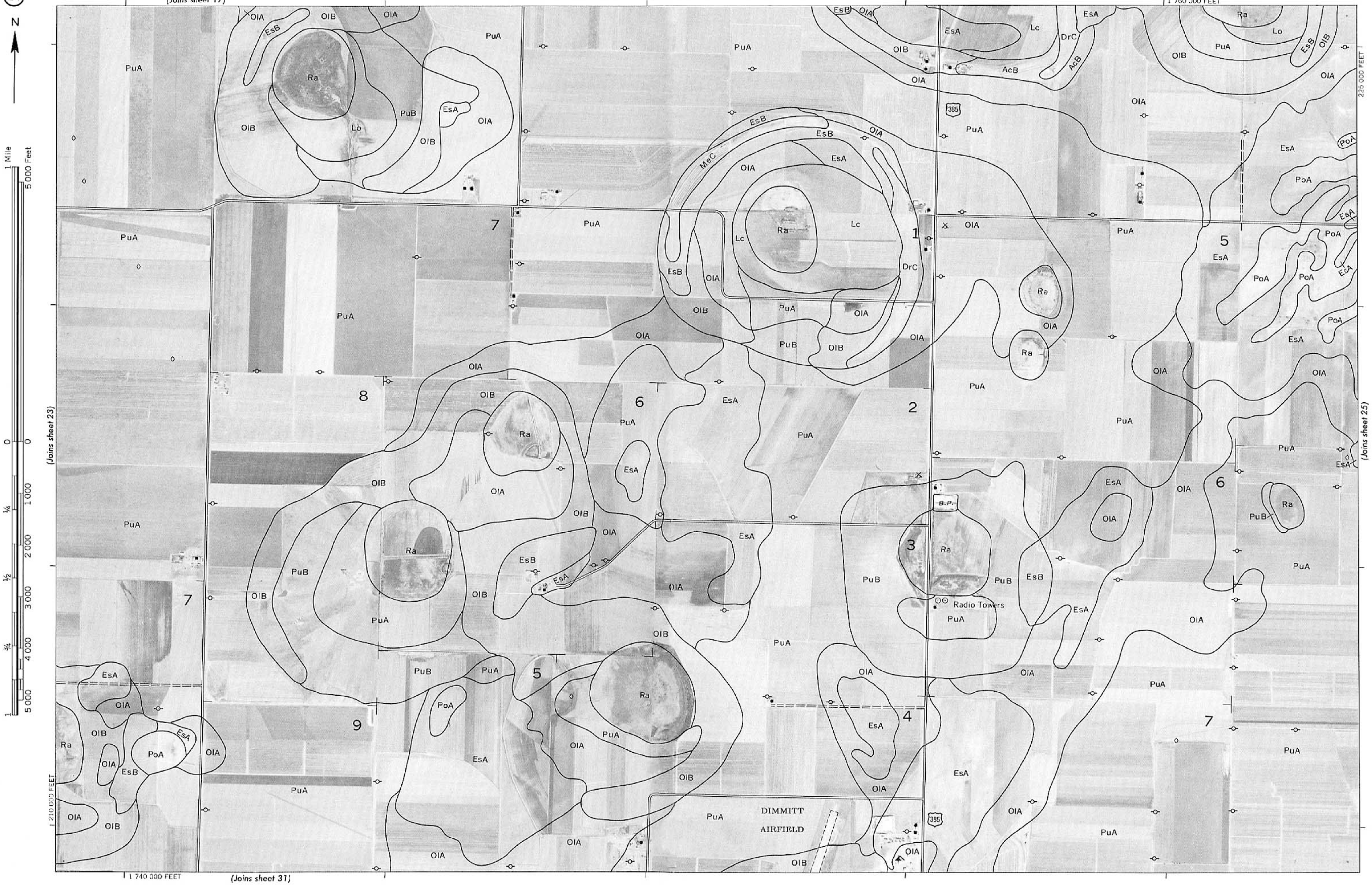
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 23



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 24



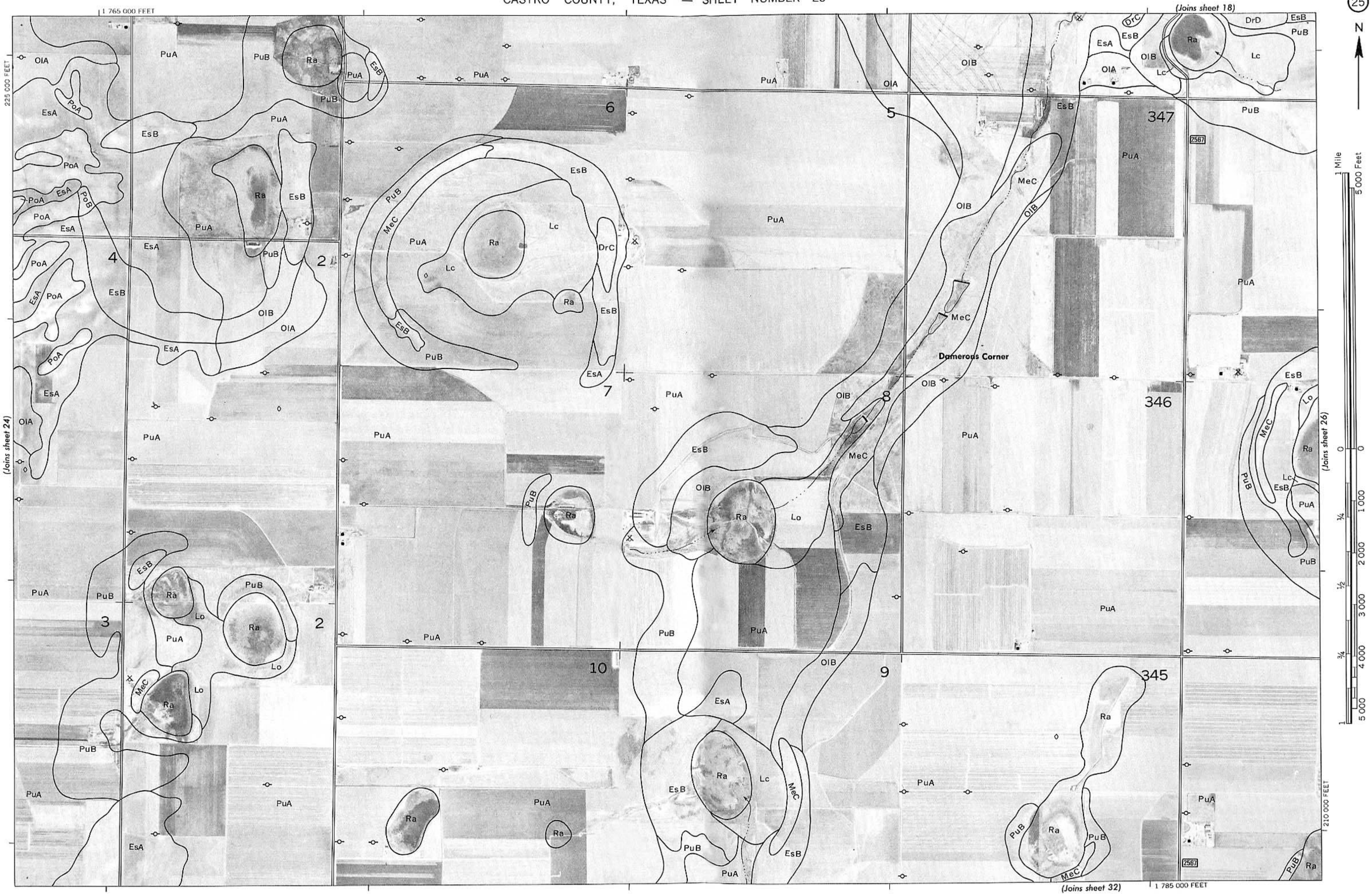
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 24

25



CASTRO COUNTY, TEXAS NO. 25

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

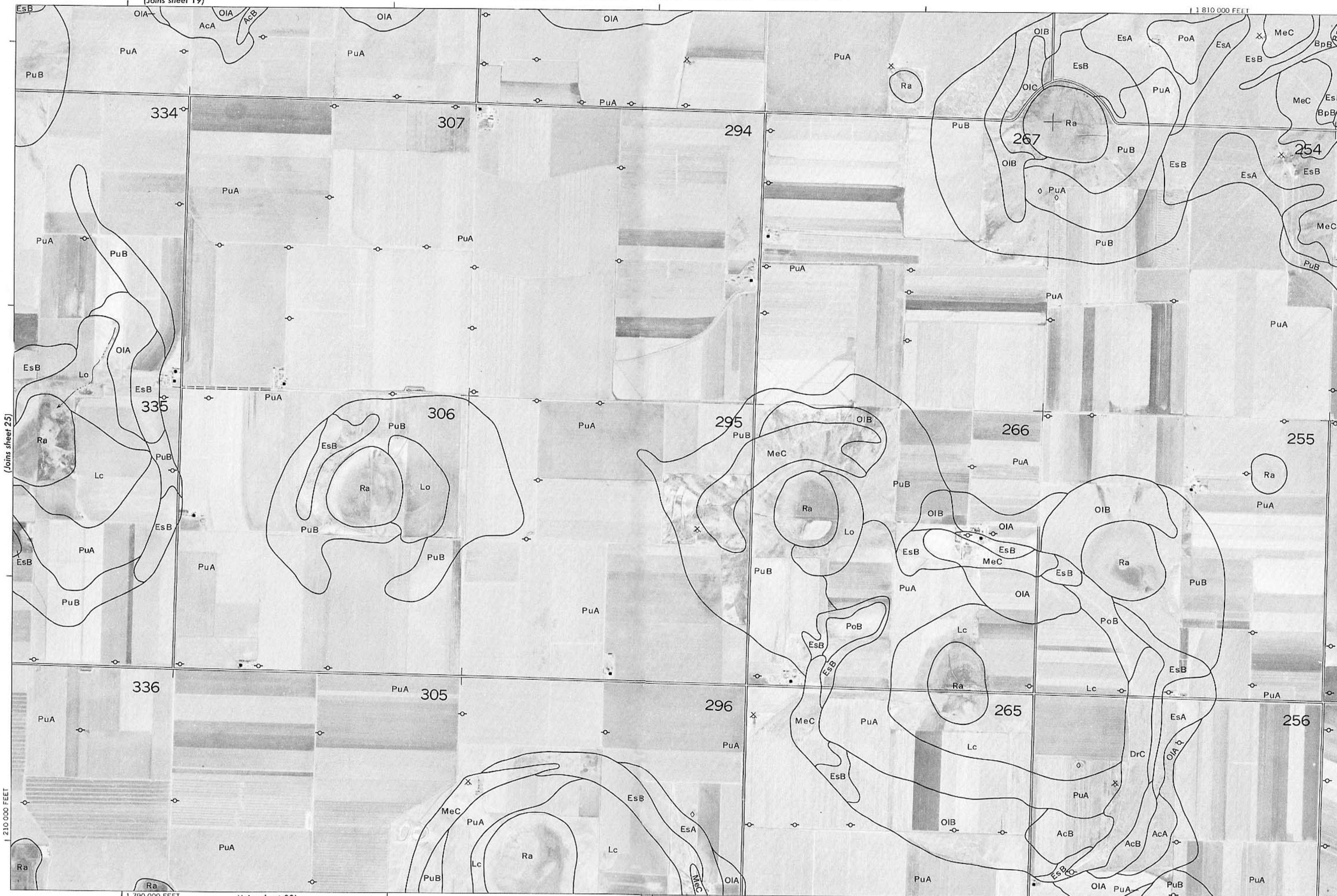
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

26

CASTRO COUNTY, TEXAS — SHEET NUMBER 26

N



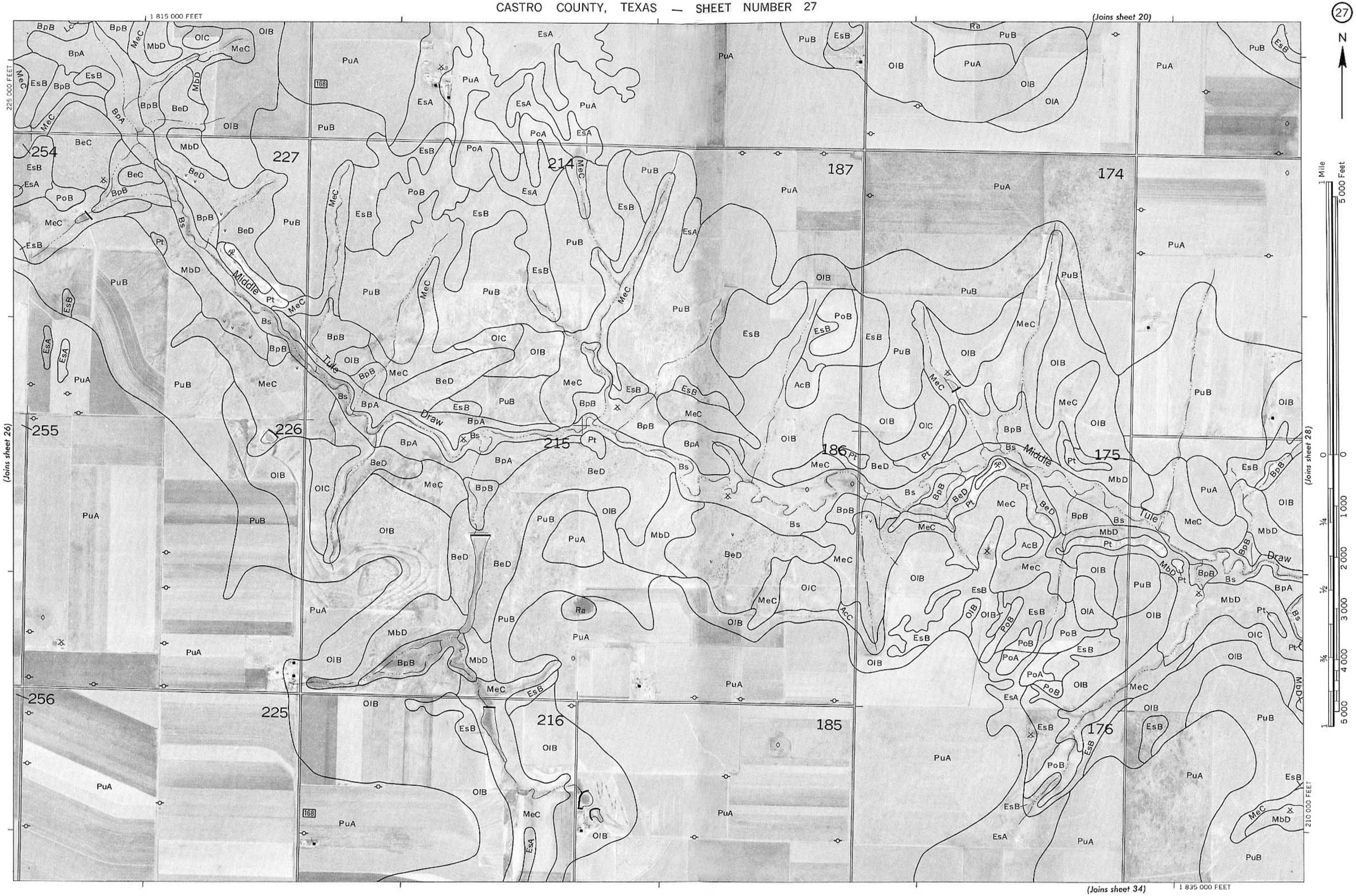
1 Mile
5 000 Feet
0 1/4 1/2 3/4 1
0 1 000 2 000 3 000 4 000 5 000

Land division corners are approximately positioned on this map.

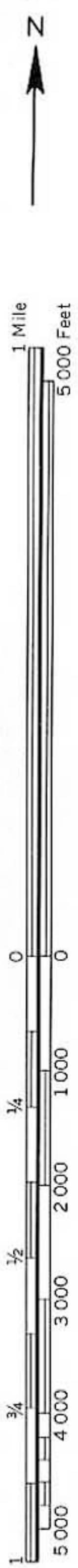
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

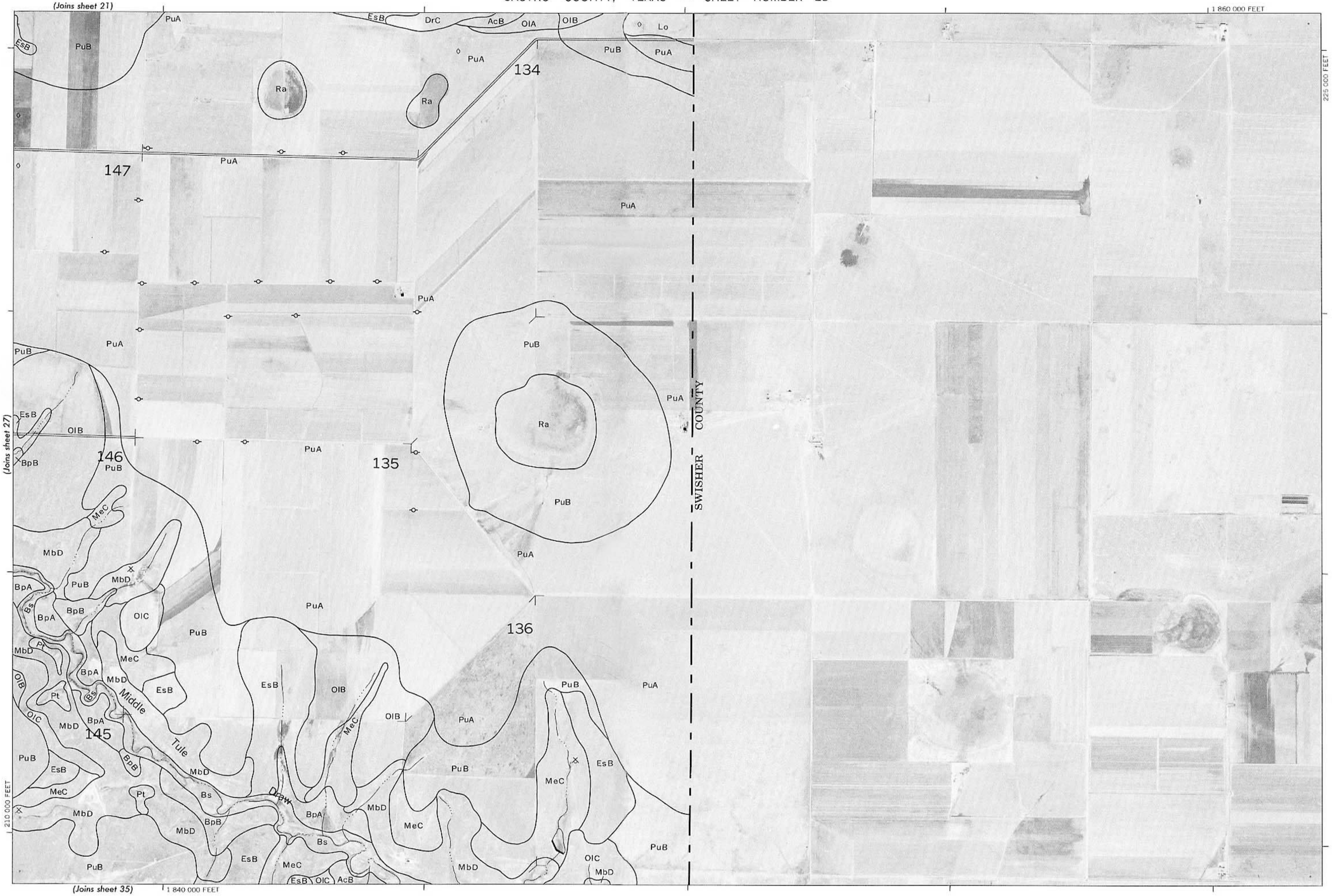
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 26



CASTRO COUNTY, TEXAS NO. 27
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.





Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS NO. 29

29

CASTRO COUNTY, TEXAS NO. 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 30

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

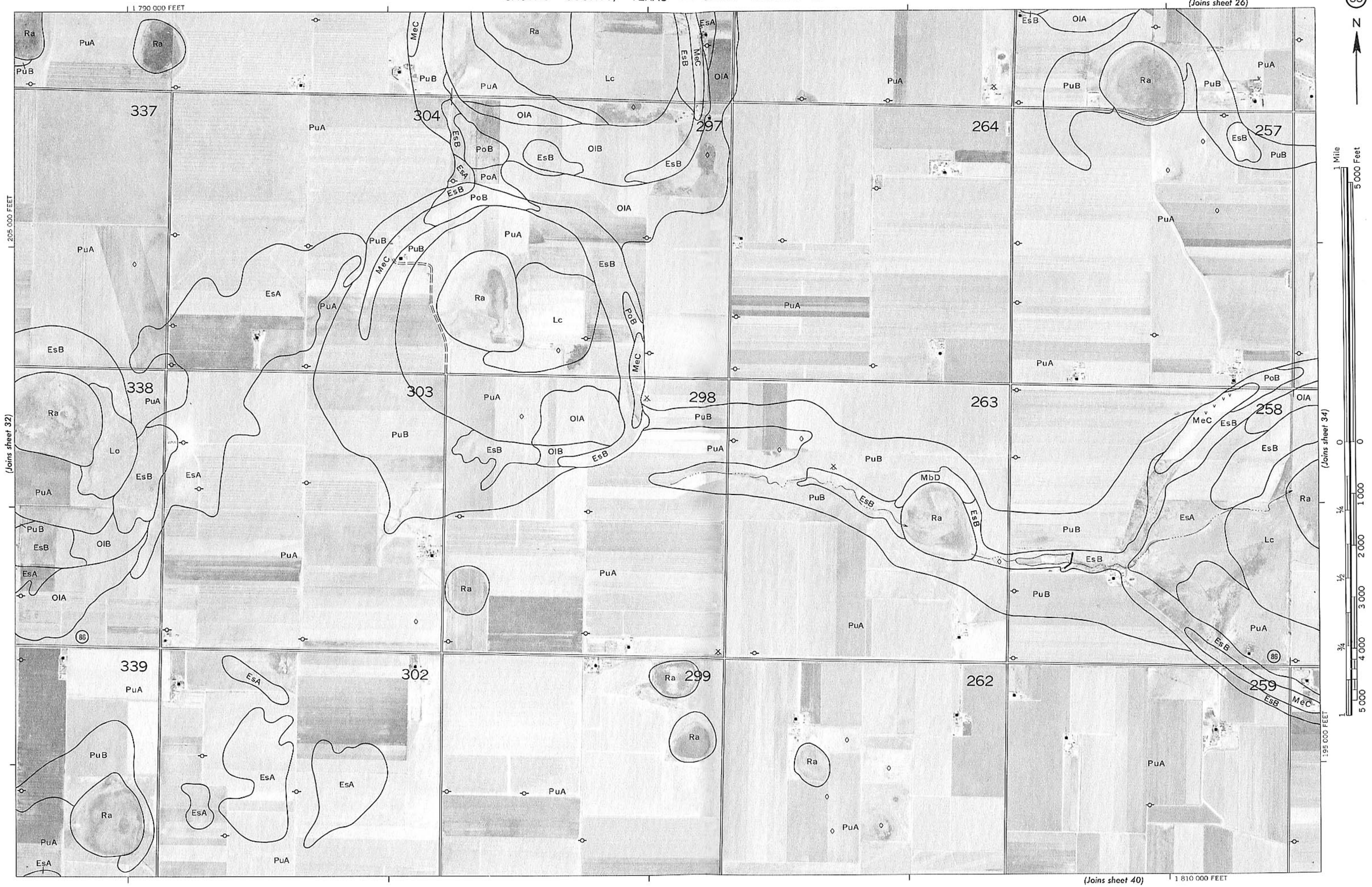
CASTRO COUNTY, TEXAS — SHEET NUMBER 32

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

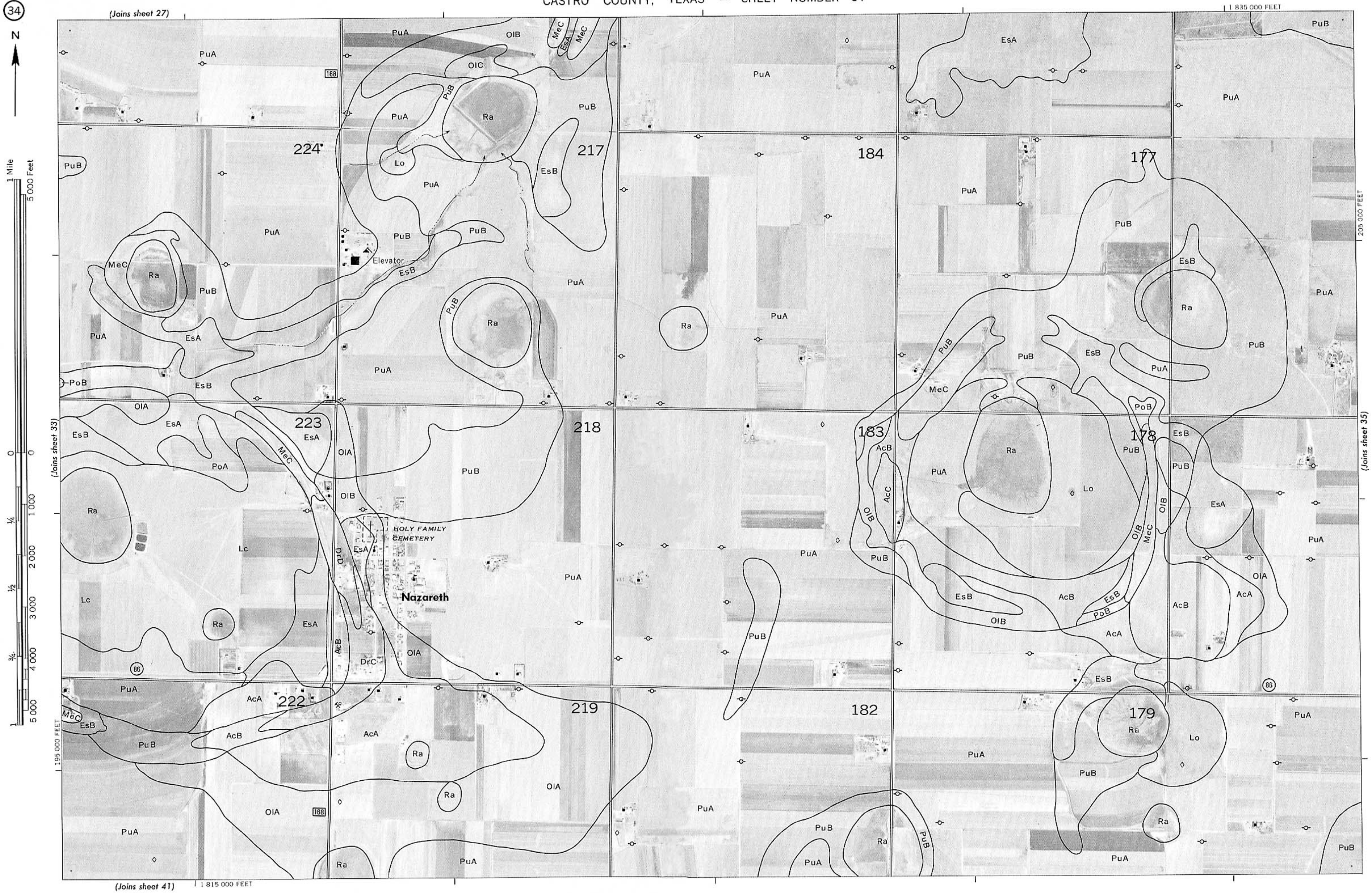
CASTRO COUNTY, TEXAS NO. 33



CASTRO COUNTY, TEXAS NO. 33

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.



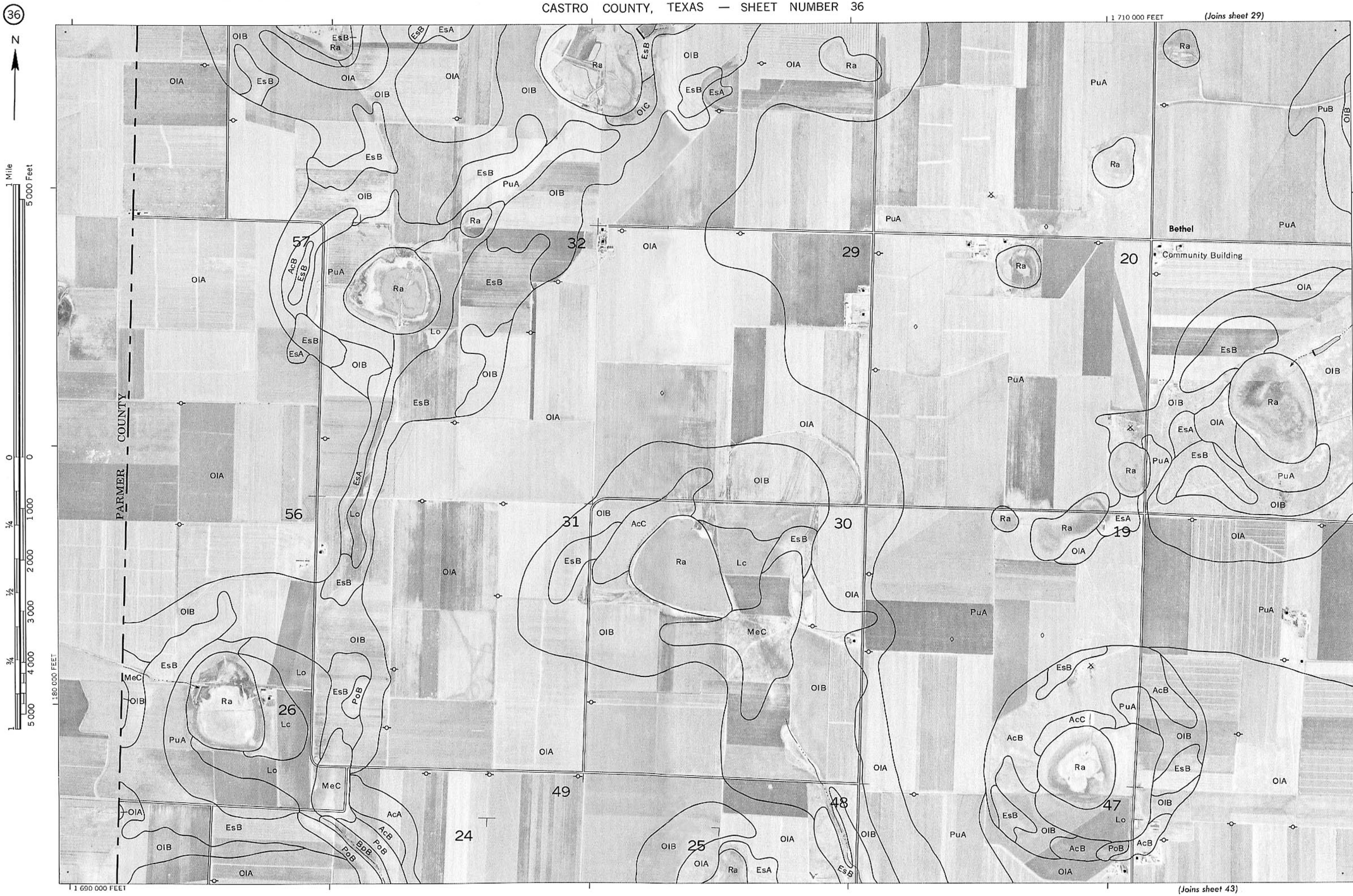
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5 000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

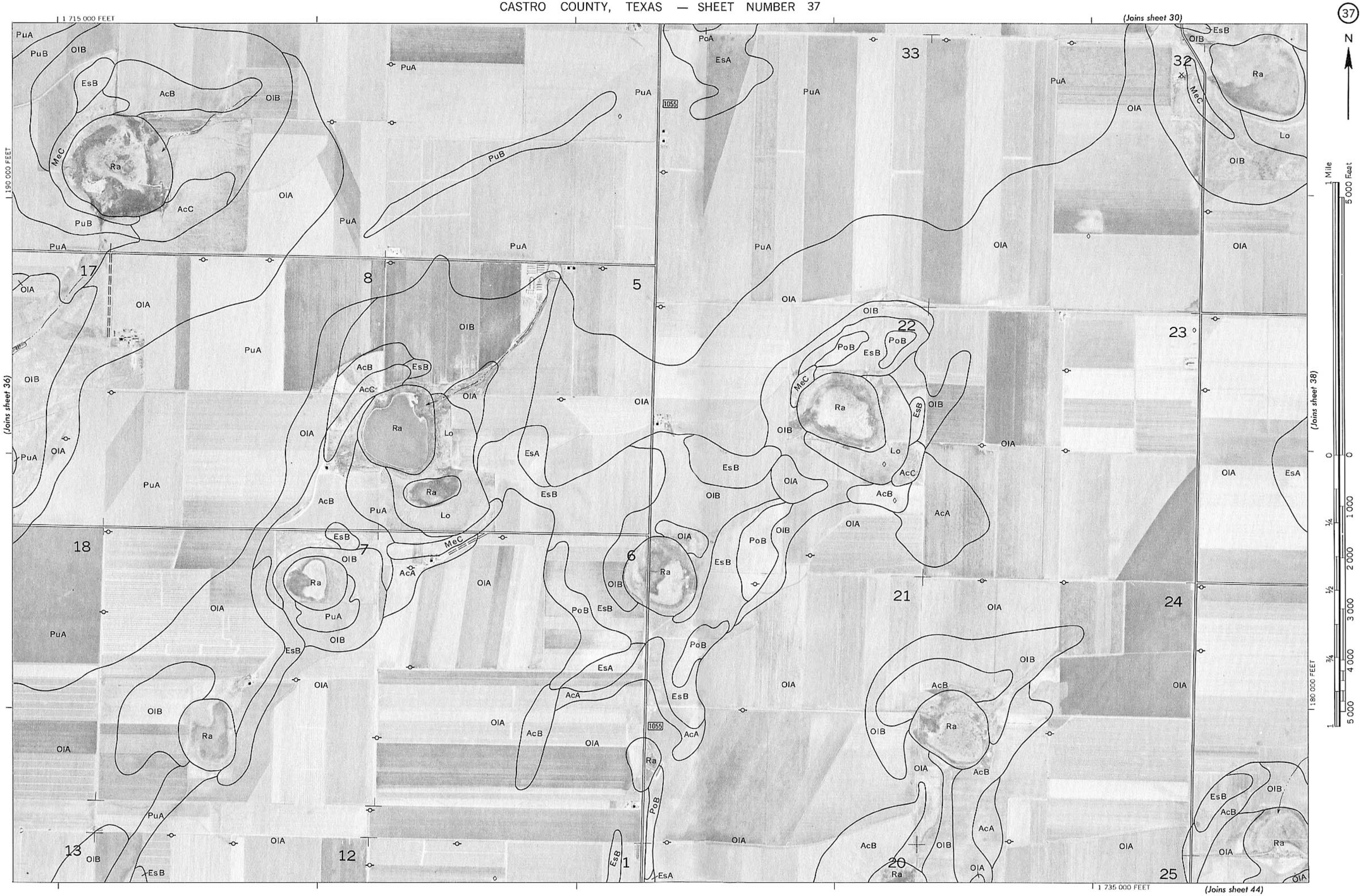
CASTRO COUNTY, TEXAS — SHEET NUMBER 36



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



CASTRO COUNTY, TEXAS NO. 37

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

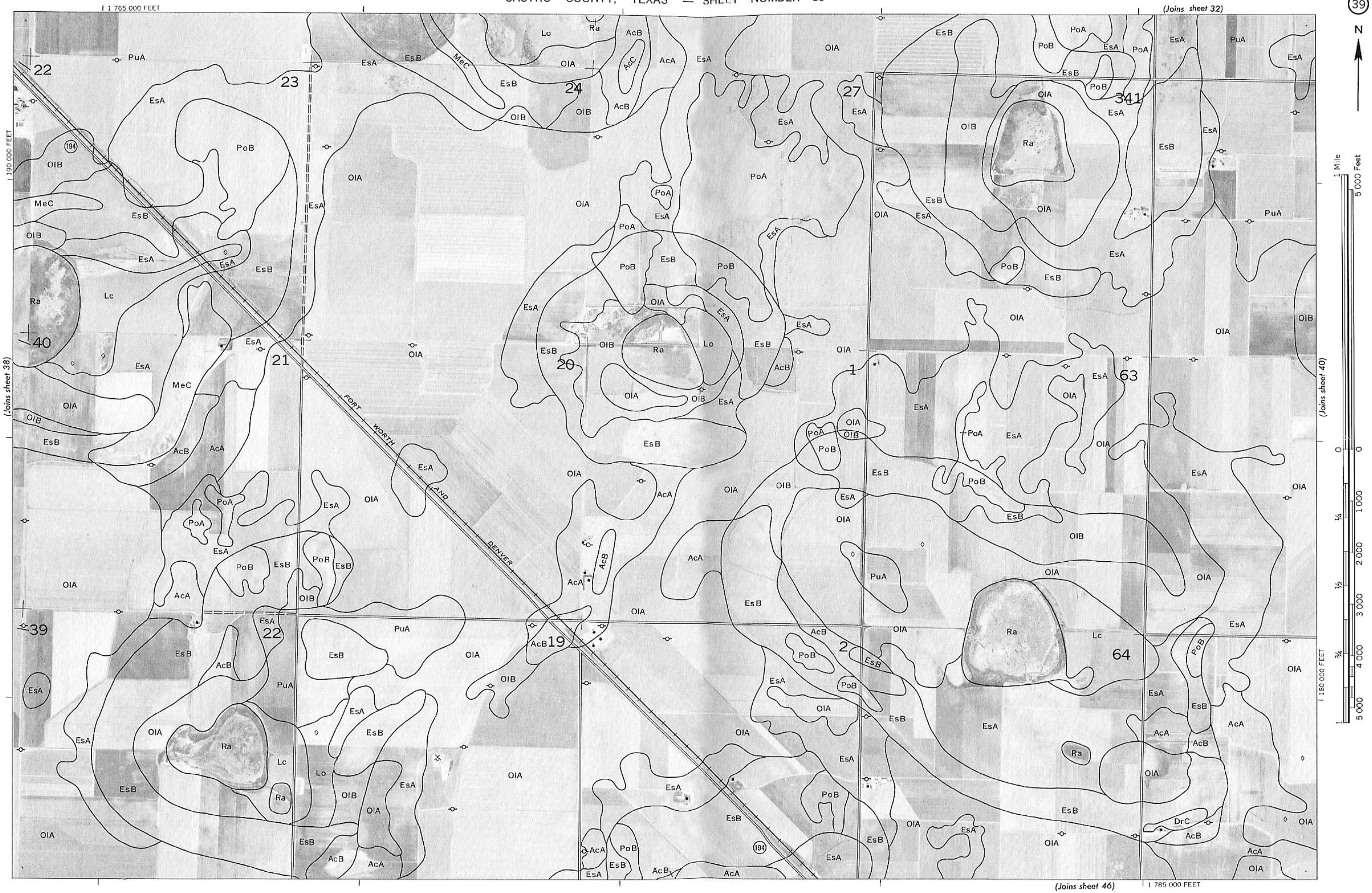
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 38

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

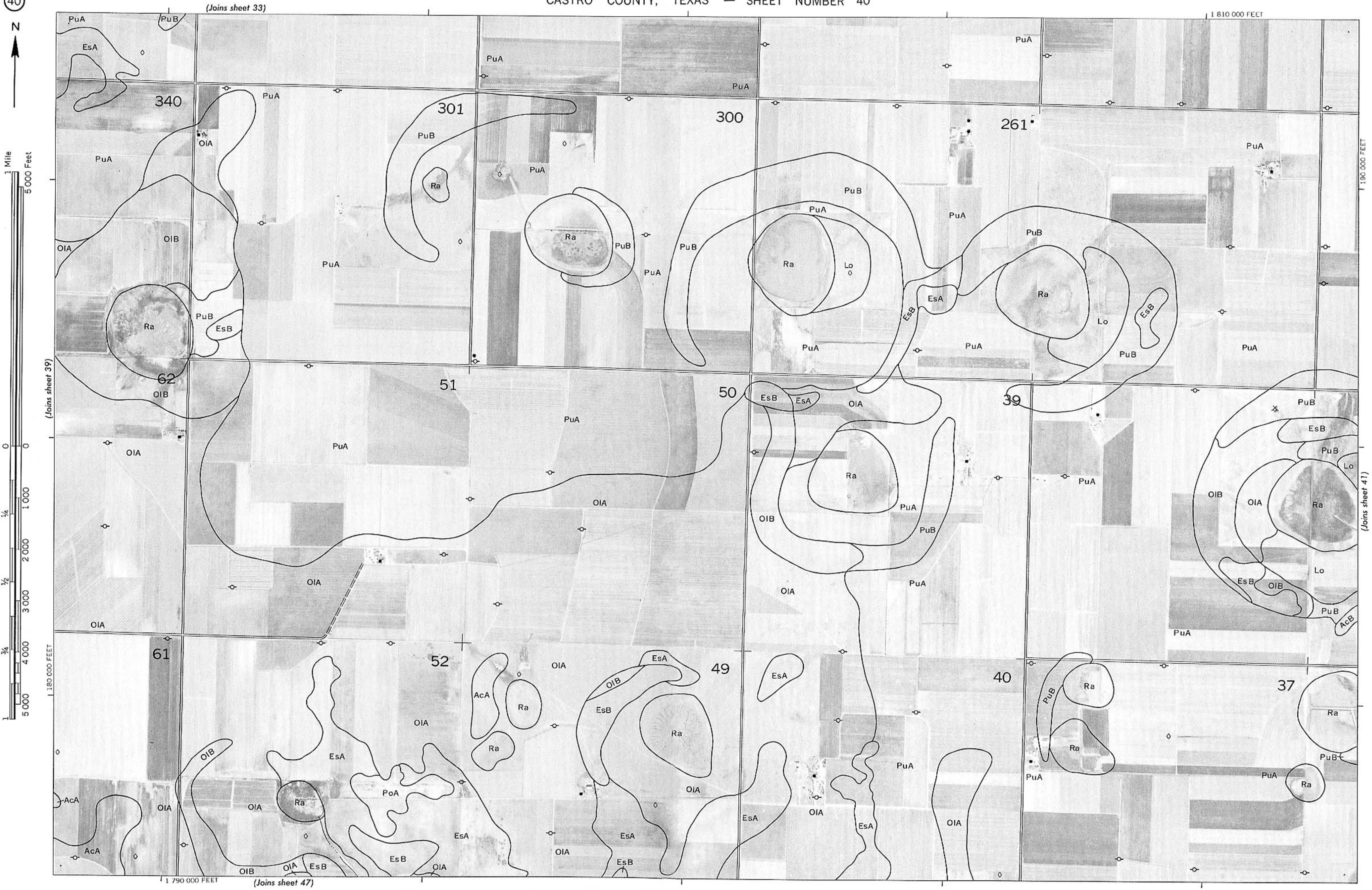


CASTRO COUNTY, TEXAS NO. 39

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

40

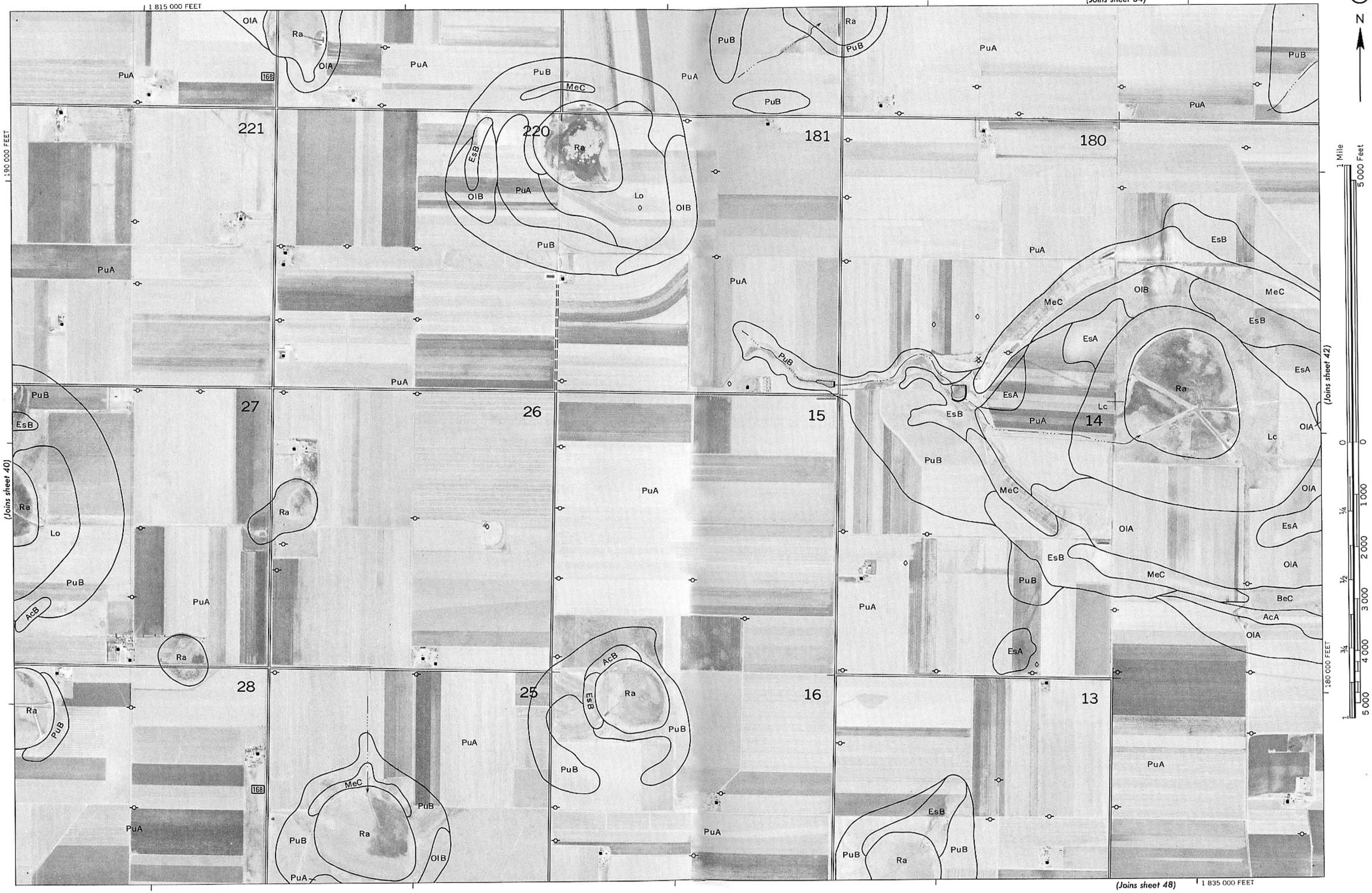
CASTRO COUNTY, TEXAS — SHEET NUMBER 40



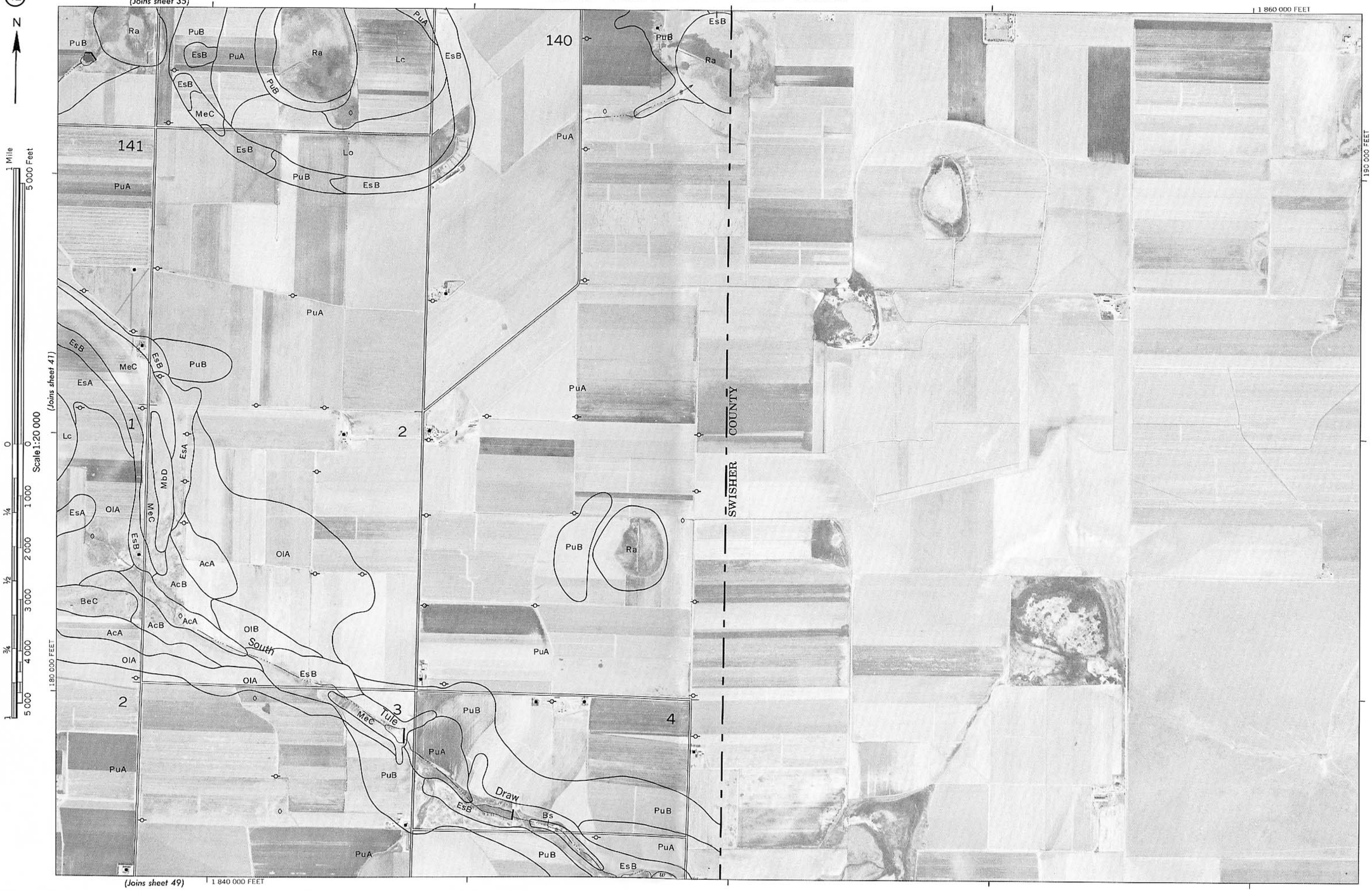
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS — SHEET NUMBER 43

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 44

Land division corners are approximately positioned on this map.

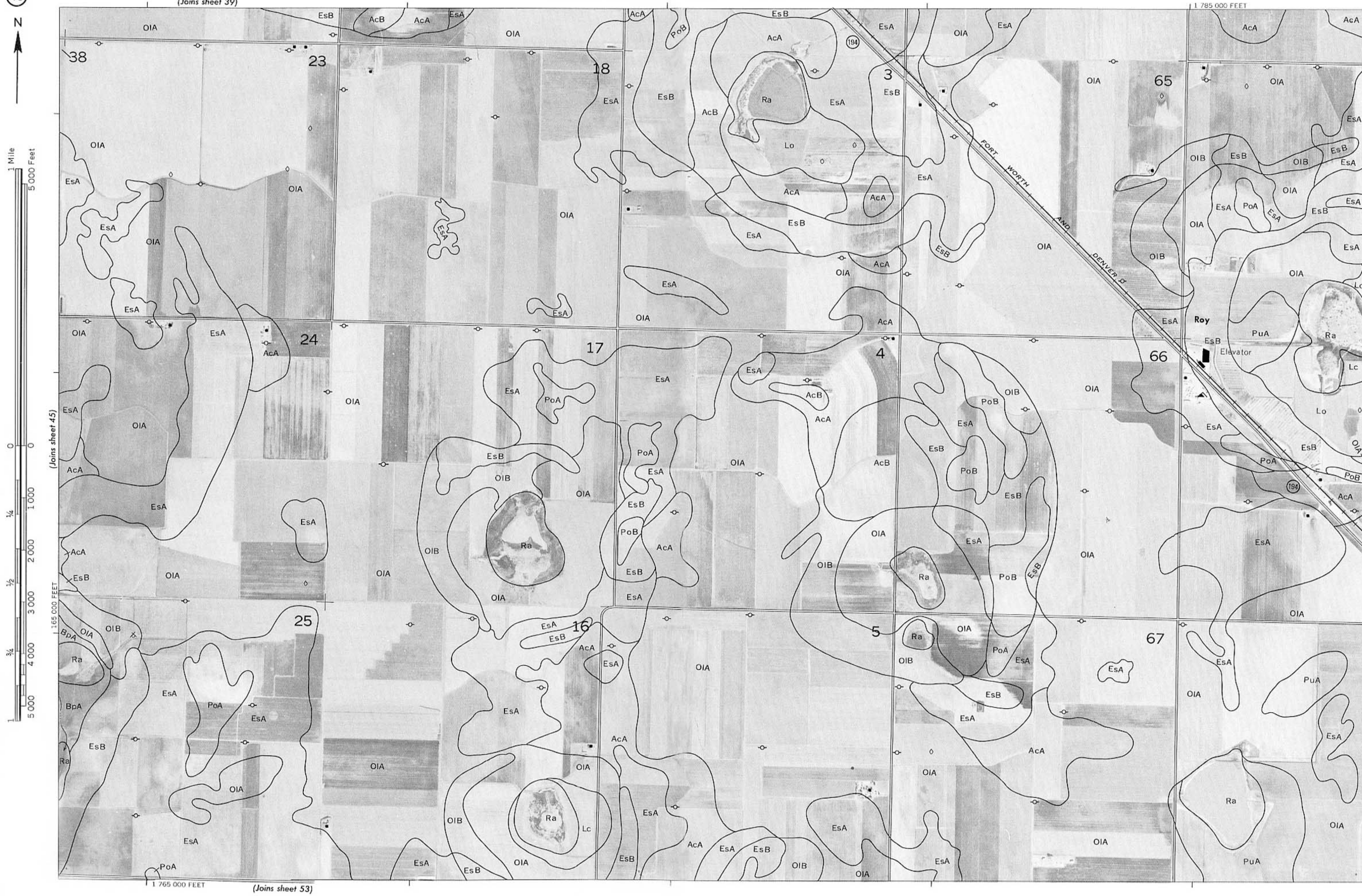
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 46

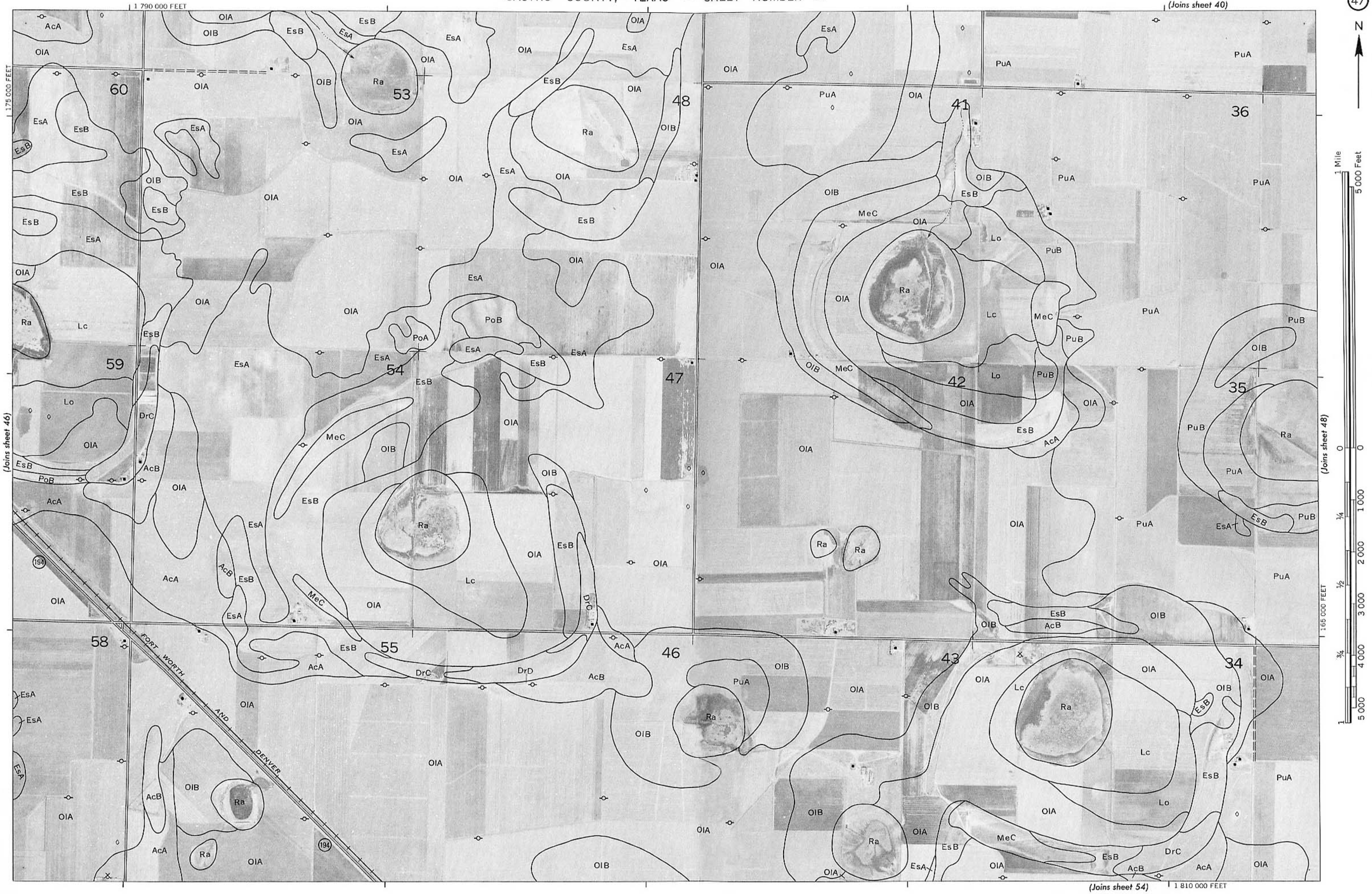
(Joins sheet 39)



Land division corners are approximately positioned on this map.

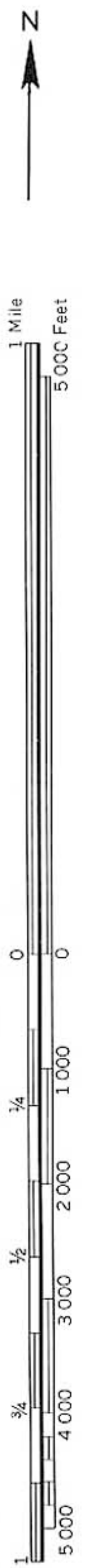
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

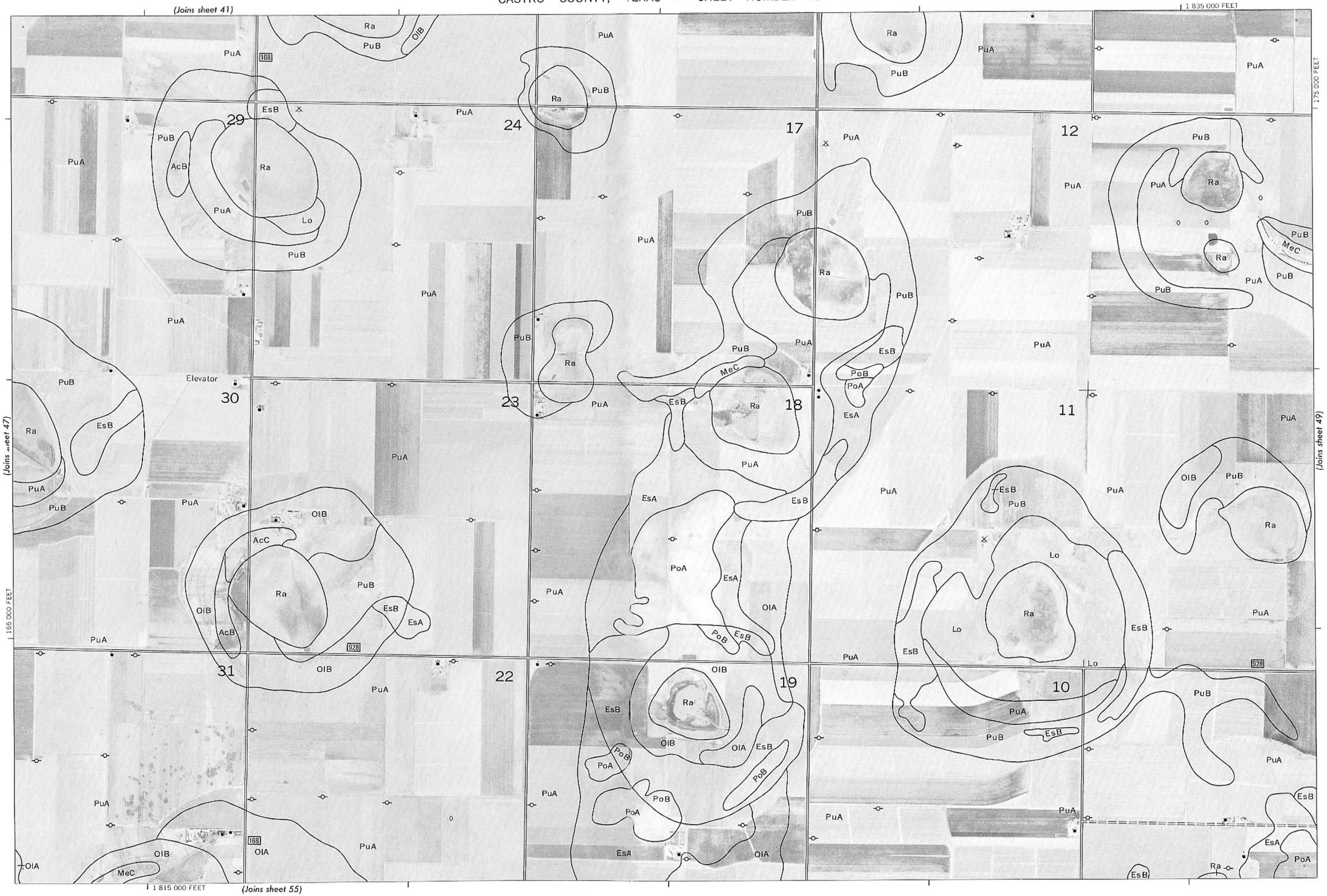
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 48





Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

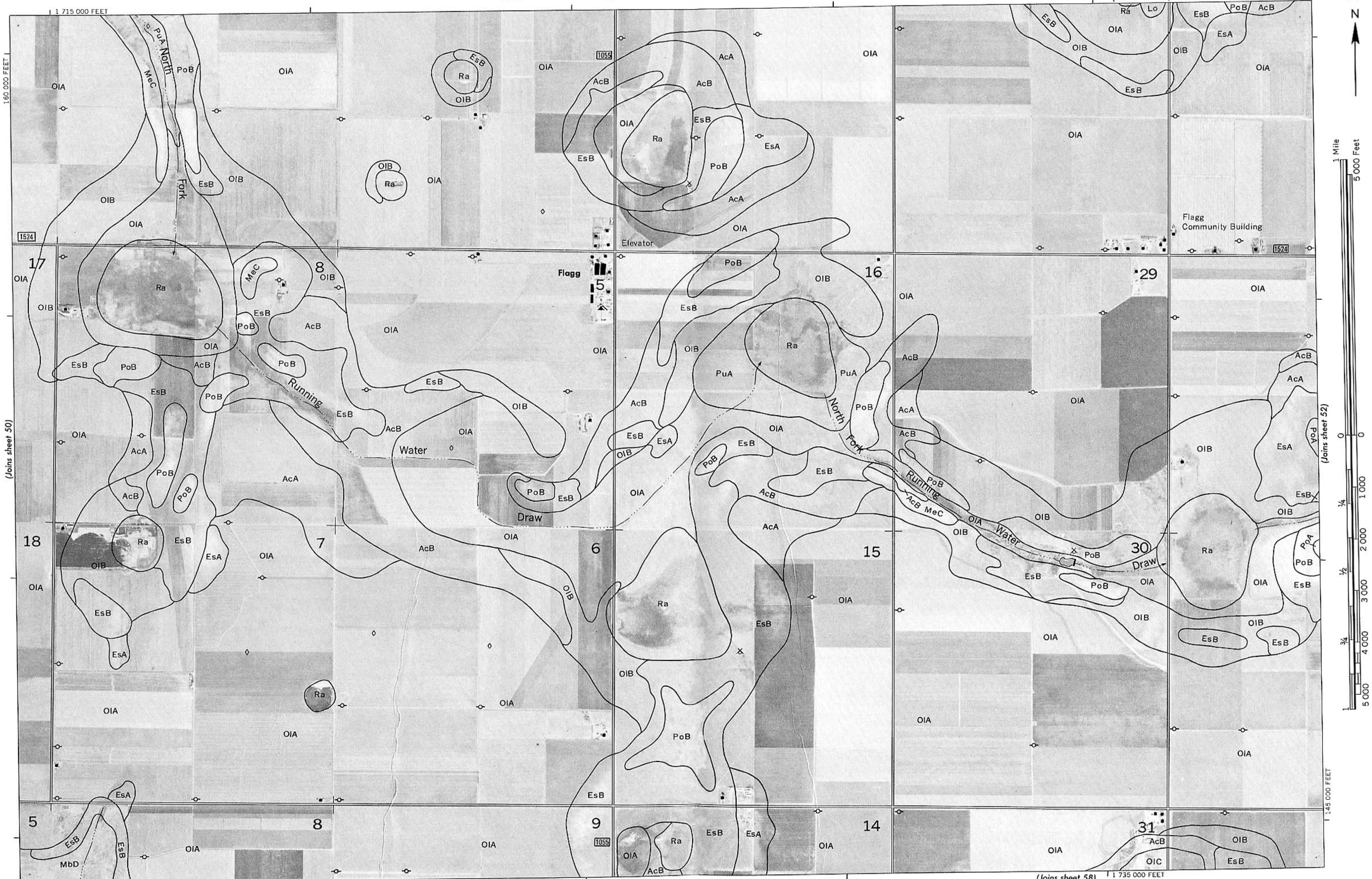
CASTRO COUNTY, TEXAS — SHEET NUMBER 50

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

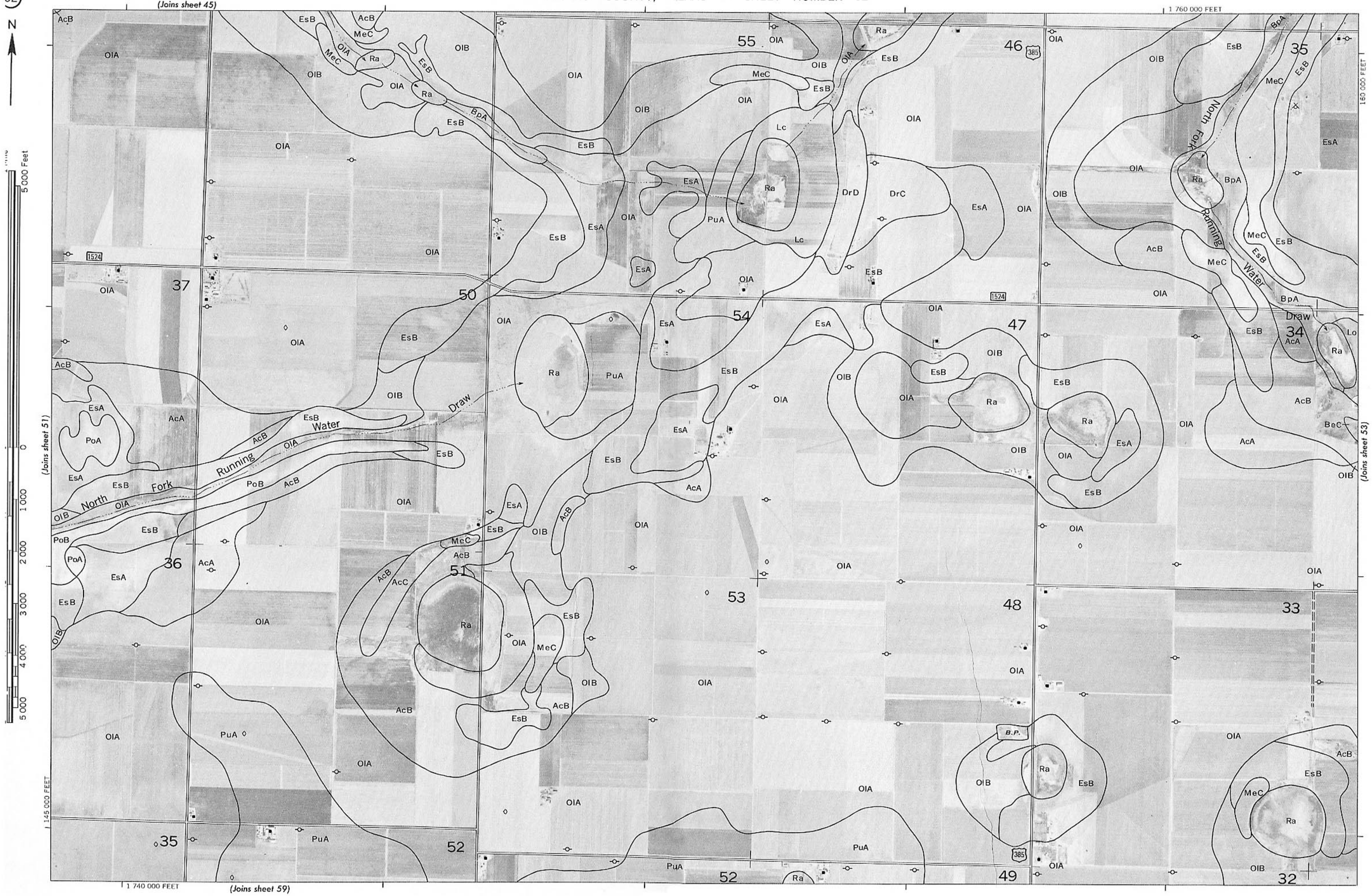
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

(51)



CASTRO COUNTY, TEXAS NO. 51

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



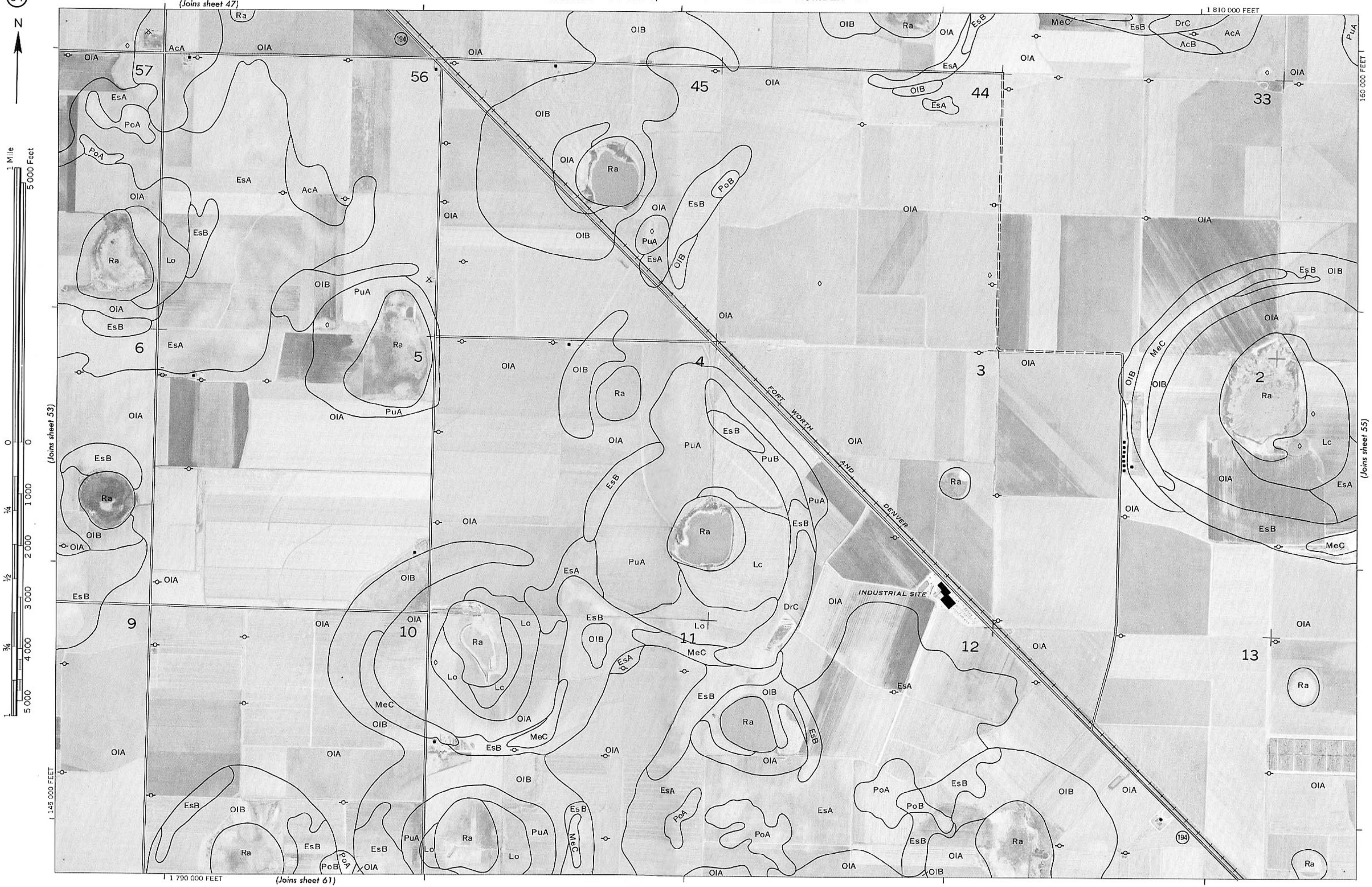
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

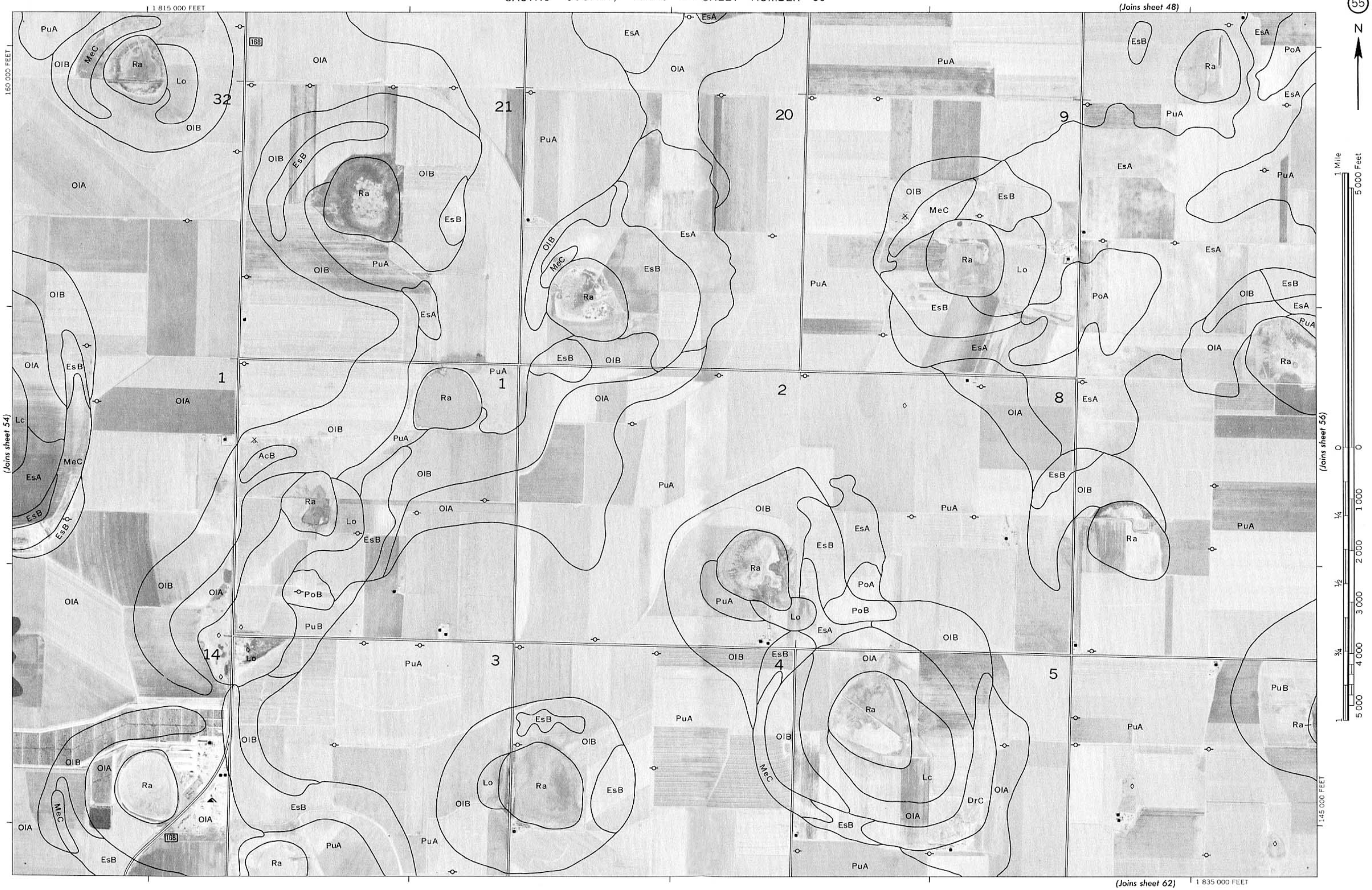
CASTRO COUNTY, TEXAS — SHEET NUMBER 54



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

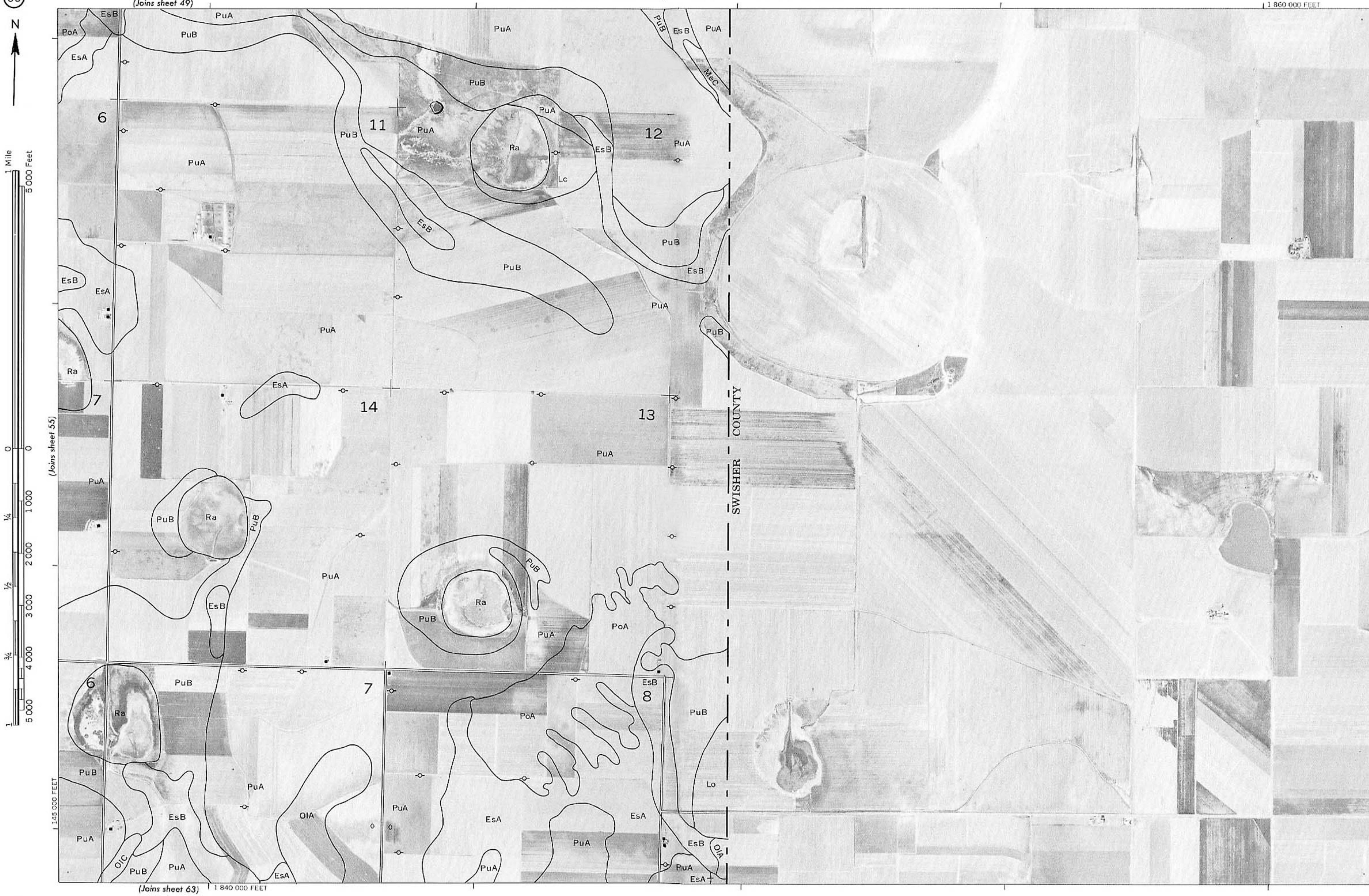
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

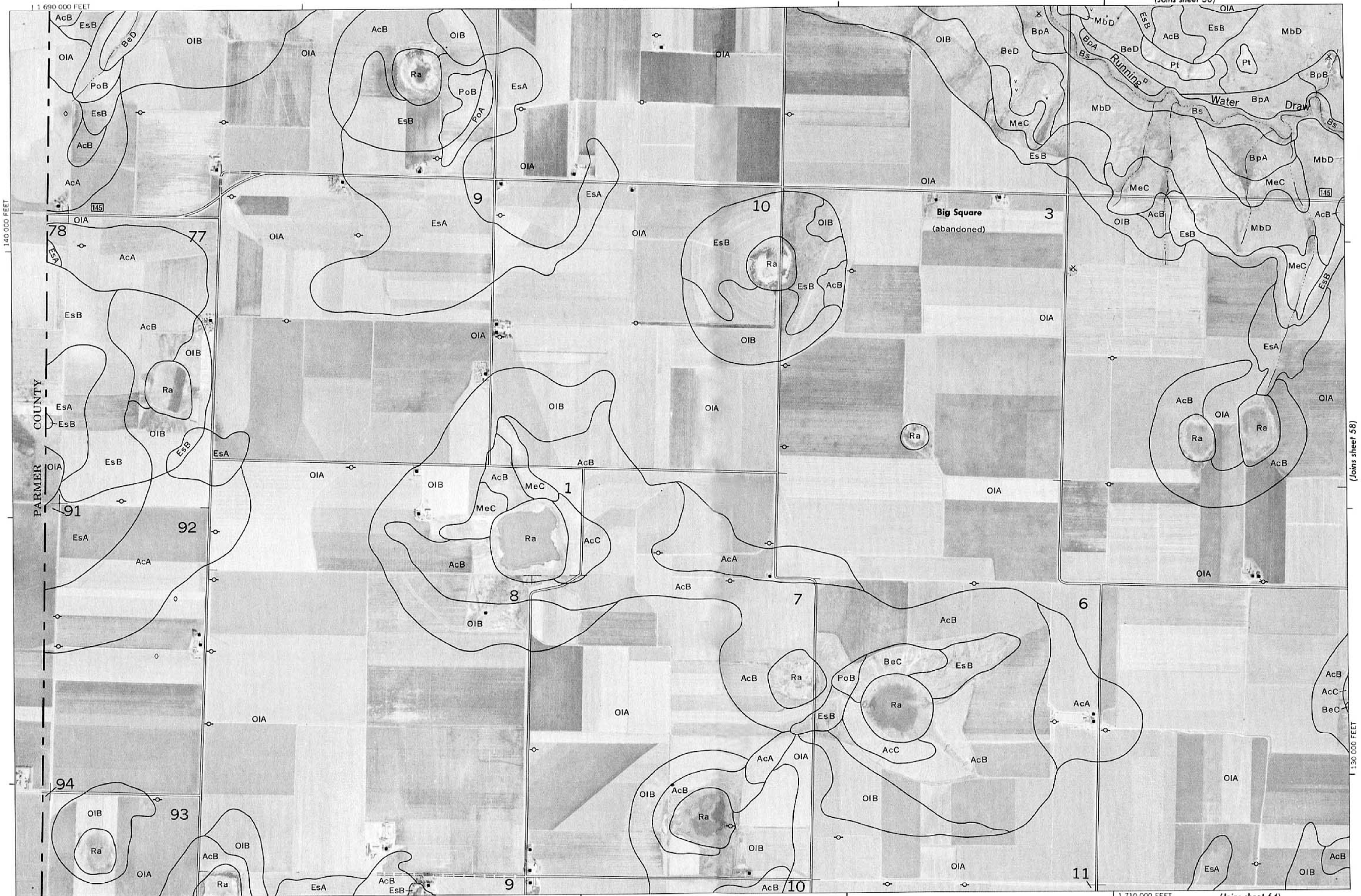
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

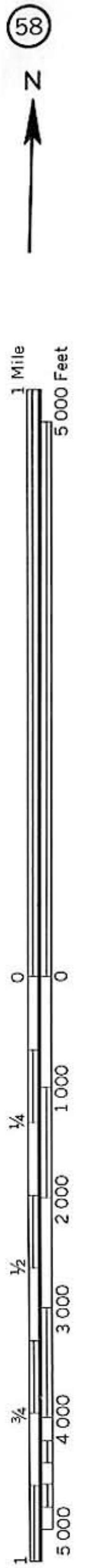
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 58

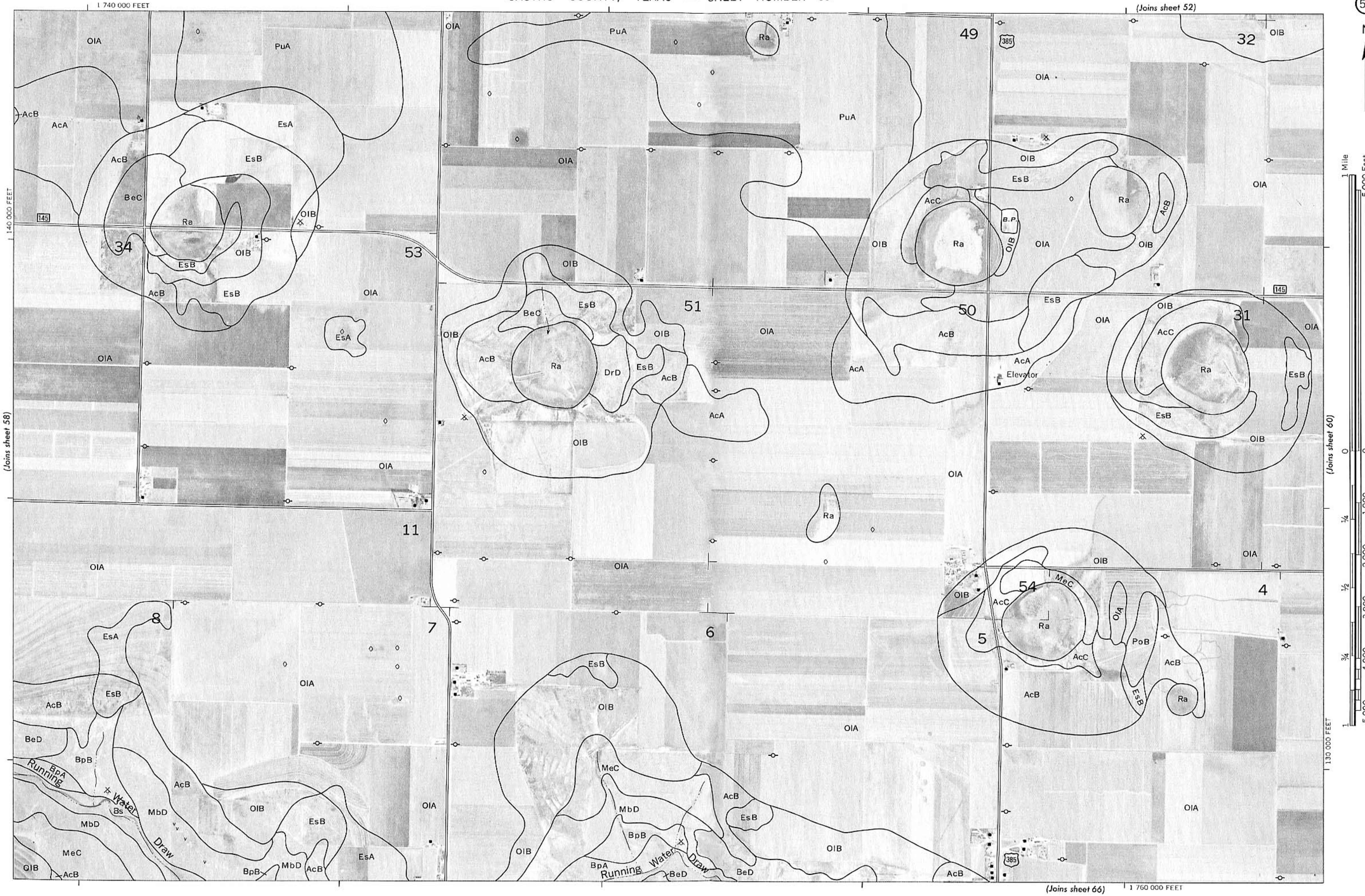


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

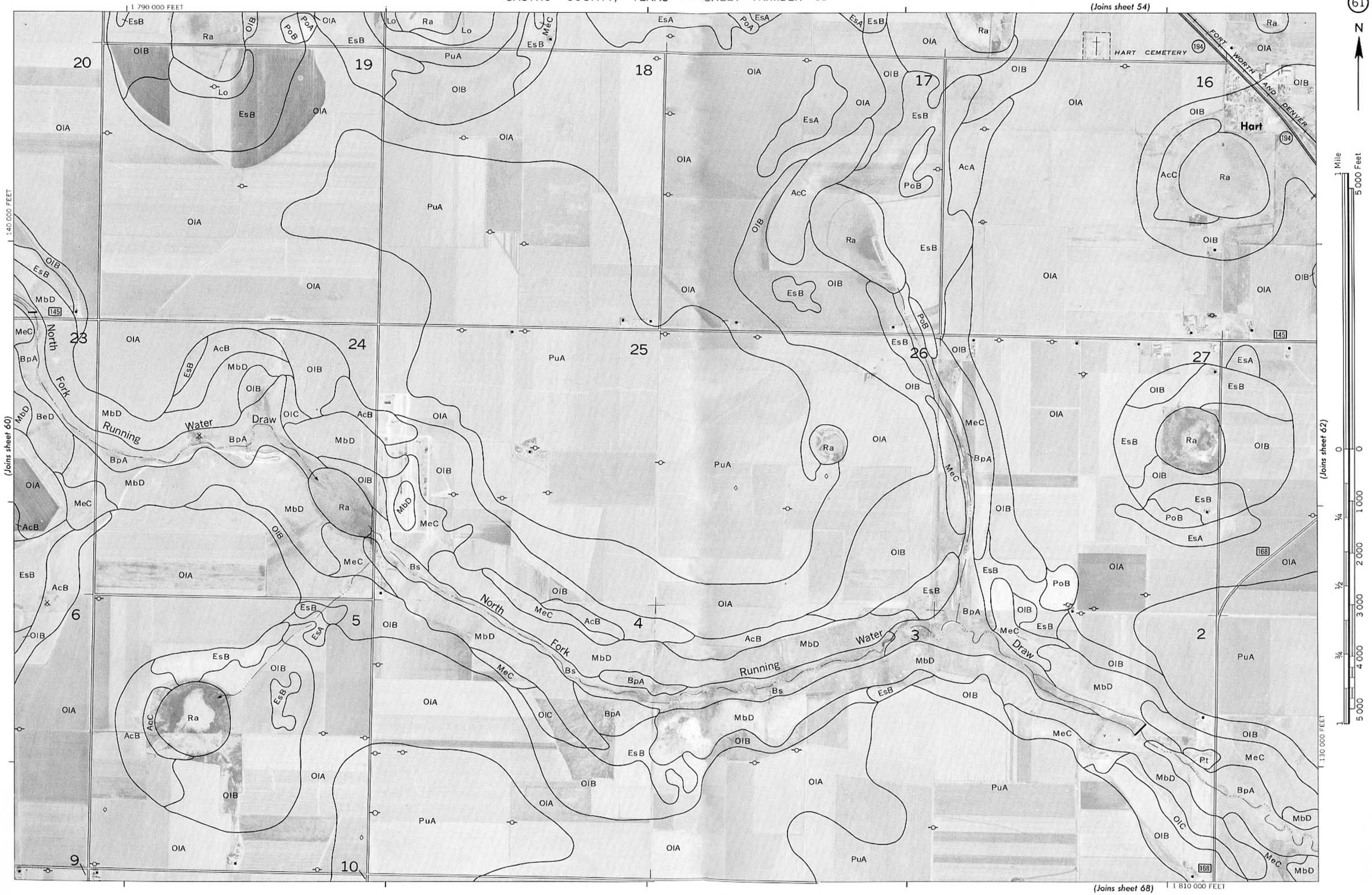
CASTRO COUNTY, TEXAS — SHEET NUMBER 59



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

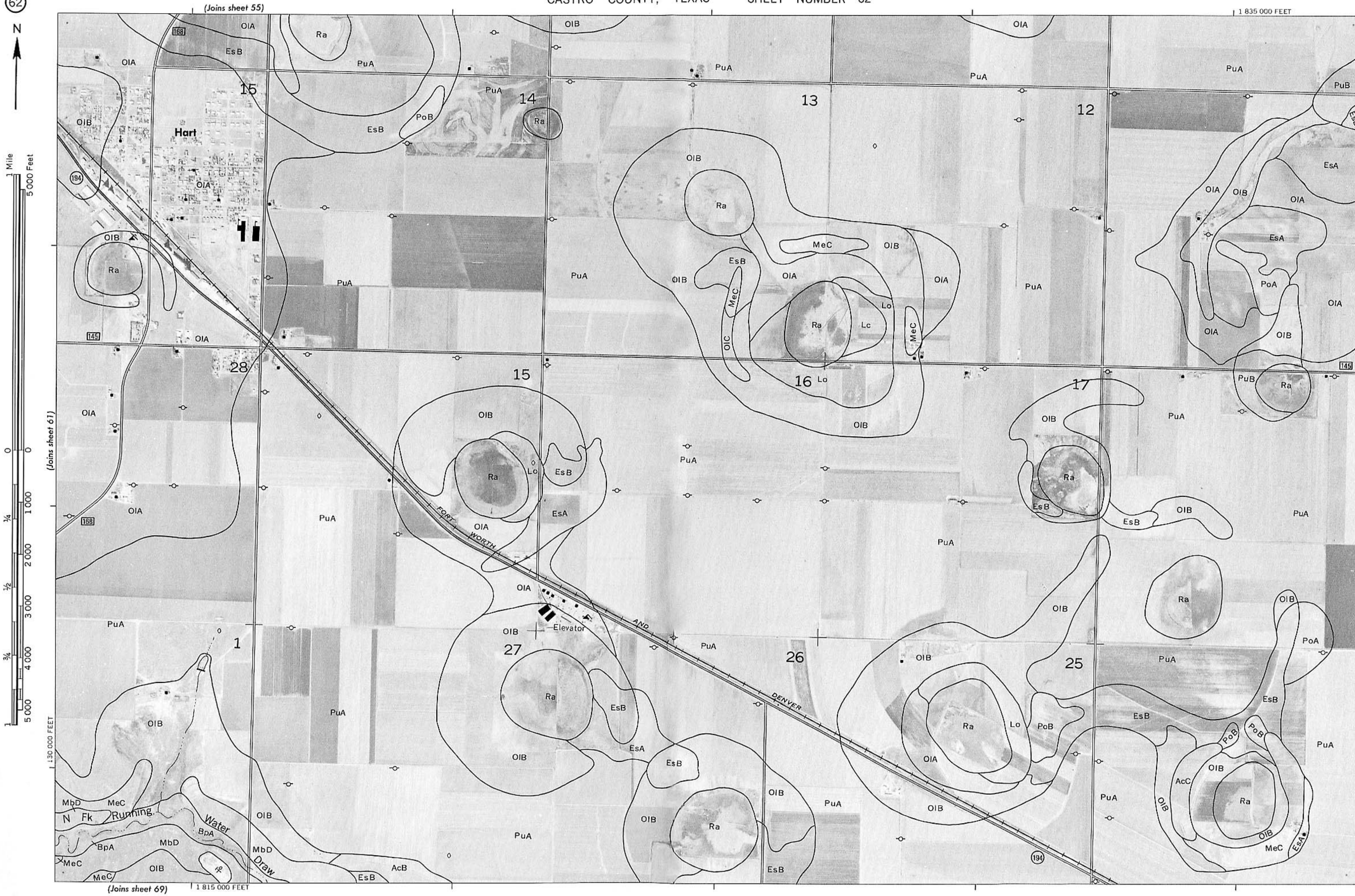
CASTRO COUNTY, TEXAS — SHEET NUMBER 60

Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 62

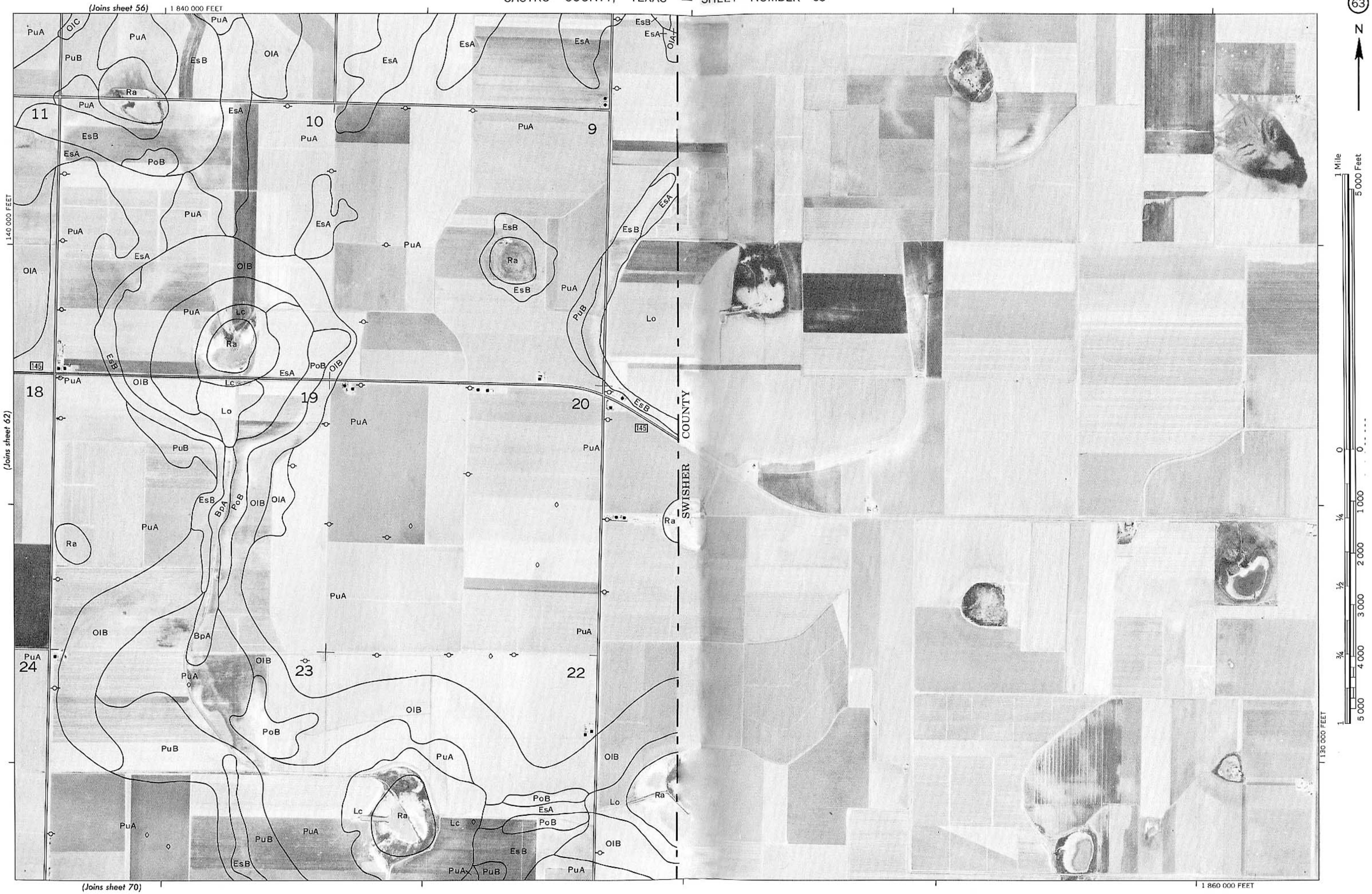


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

CASTRO COUNTY, TEXAS — SHEET NUMBER 63



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

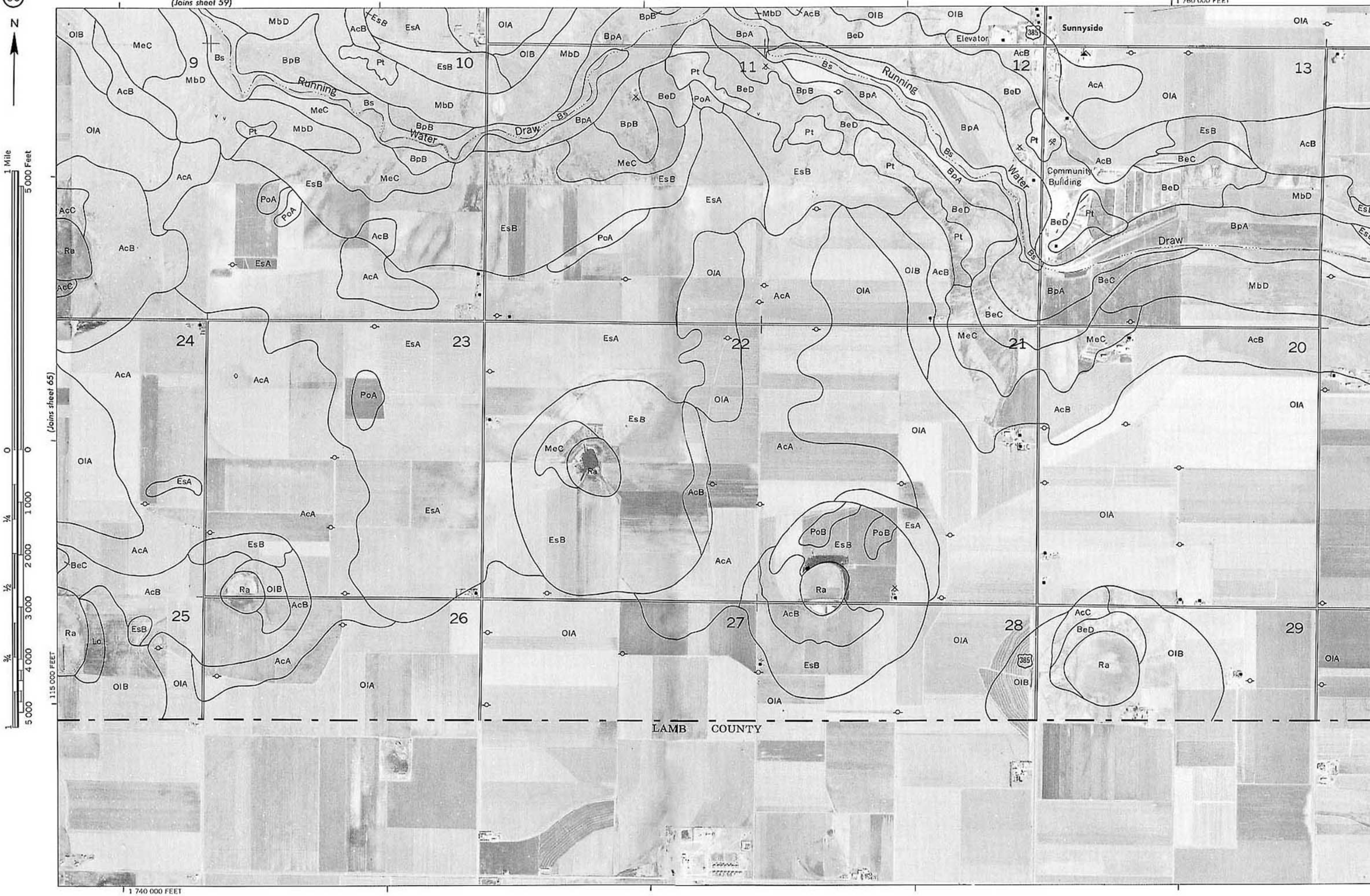
CASTRO COUNTY, TEXAS — SHEET NUMBER 64

CASTRO COUNTY, TEXAS — SHEET NUMBER 65

65

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 66



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 68

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

CASTRO COUNTY, TEXAS — SHEET NUMBER 70

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.